JUN 30 1924

Founded March 1, 1874 — *Fifty Years of Service*

Electrical World

McGraw-Hill Company, Inc. — *June 28, 1924* — Twenty-five Cents per Copy

Generation

Few can equal the experience of the Moloney Electric Company in the development of modern high voltage transformers.

We are exclusively manufacturers of transformers and are in a position to give our individual and undivided attention to your power transformer requirements.

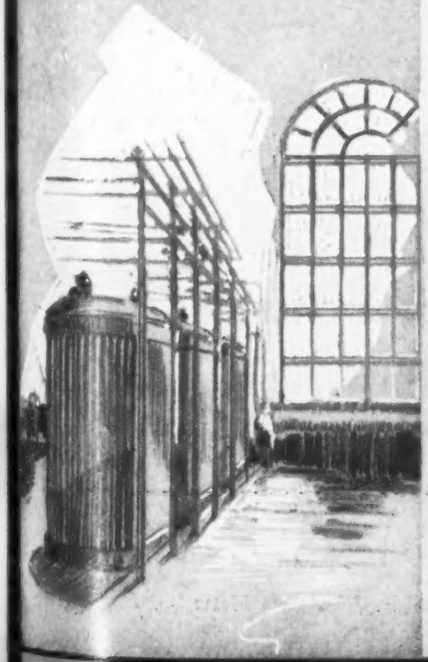
Transmission

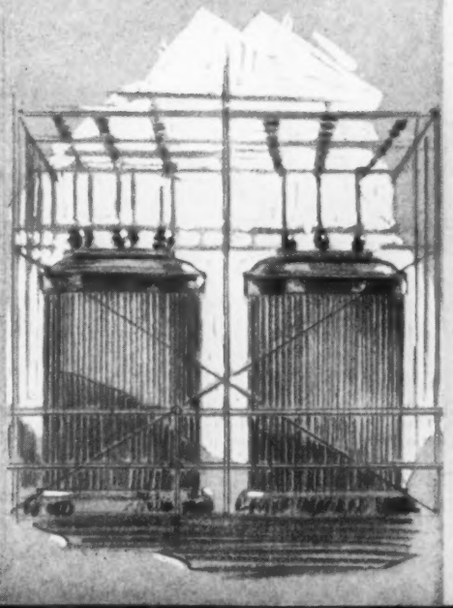
In hundreds of sub-stations, indoors and outdoors, Moloney Transformers are rendering a service that fully justifies our painstaking methods of design and construction, which includes more liberal designs and the selection of only the best materials available, regardless of price. You can depend upon a Moloney Transformer in any kind of transmission service.

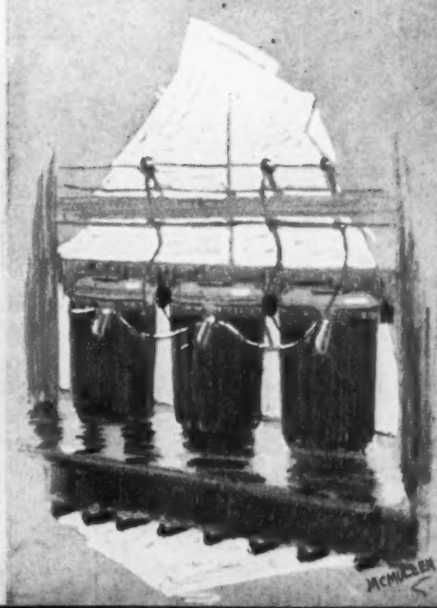
Distribution

For the past twenty-seven years Moloney distribution transformers have been widely and actively engaged in furnishing power to industry in all sections of America.

The fact that they are so repeatedly purchased for this class of service is the best indication of the satisfaction they are giving. Complete information on a complete and superior line of Moloney transformers will be furnished at your request.







MOLONEY TRANSFORMERS

MOLONEY ELECTRIC CO., St Louis, Missouri

Announcing the Metropolitan AA Rotary —the Meter Switch with the AA Rating

Closed Position

Your customers are anxious to help you give them better service. When they know the safety and ease with which fuses can be replaced in the Metropolitan AA Rotary Switch, they will not call "emergency" but will renew the fuses themselves.

With the Metropolitan AA Rotary there is no reason for breaking seal to replace fuses. It is all done in one operation—moving handle in "OFF" position brings fuses to view for replacing and disconnects all sources of current.

THE METROPOLITAN DEVICE CORPORATION HAS BEEN A MANUFACTURER OF "AA" SWITCHES FOR TEN YEARS.

METROPOLITAN DEVICE CORPORATION
1250 Atlantic Avenue, Brooklyn, N. Y.

Gentlemen: Please send full information on the Metropolitan AA Rotary Meter Switch.

Name ..... Company .....

Address ..... Title .....

Electrical World

The consolidation of Electrical World, Electrical Engineer and American Electrician

Published by McGraw-Hill Company, Inc.

W. H. ONKEN, JR
Editor

HAROLD V. BOZELL
Editor

Volume 83 — New York, Saturday, June 28, 1924 — *Number* 26

The Cost of Light Comes Down Again

THERE is something exhilarating in the news that on July 1 the price of "Mazda" lamps is coming down once again—the fifth reduction in about two years, aggregating a total of 37 per cent, achieved through continued improvement in the process of manufacture. For to the public the cost of lamps is closely akin to the cost of light, and the falling price of this, the article most commonly purchased to maintain the lighting of the home, naturally is accepted as a sort of index of the general cost of using electricity. Automatically it gives the impression that electricity is the one modern service that is constantly lightening the burden of the cost of living. And this is well.

There have been so many of these reductions that electrical men may perhaps be now disposed to accept them as a matter of course—the reflection of a trend. But they are more than that. Such a basic benefit offered to the consumer is of the utmost importance in the market. It should be made the opportunity not only for intensive selling throughout the lighting field, in every community, but broadly for the interpretation to the public of the progressive economy to the consumer which today places the entire electrical industry in a unique position.

Poor Lighting— the Boll Weevil of Industry

THE annual loss to crops and stored products in the United States through the depredations of insects and rodents is estimated to be more than two and a quarter billion dollars. Of all the insects, the boll weevil is the most destructive. Three hundred million dollars' annual injury is laid at his door—or would be laid there if he had a door. Greater enemies to the cost of living, however, than even these rapacious insects exist, unheeded and uncombated. Of these, poor lighting is one of the most formidable.

Sufficient data have accumulated in laboratories and in factories to put it beyond dispute that improved lighting throughout the industries of the nation would result in a large increase in production without appreciable additional cost. A conservative figure points to a 10 per cent increase in production above the price of the better lighting. This alone would add to the nation's wealth a sum equal to all the damage due to insects and rodents. A further saving would be caused by reduction in the number of accidents to men and machinery. The conclusion arrived at is that inadequate and improper lighting is fifteen times more damaging than the boll weevil and twice as destructive as all the insects and rodents in this country.

Science has not yet found out how to exterminate all of the crop-eating pests that help to maintain the high cost of living. Experts in electric lighting, however, know how to rid the factories of their boll weevil. As long as it is permitted to take its toll the industries must be convicted of indifference to a preventable waste the results of which are as disastrous as those brought about by insects, rodents or excessive taxation.

Serious Power Shortage in California

SUFFERING from the worst drought that has ever been known in the history of the state, California finds itself in the grip of a serious shortage of electricity. In the southern part of the state the hydroelectric companies have already limited users to 80 per cent of their customary supply. The question naturally arises, "Where is the vaunted superiority of private initiative and enterprise?" and without doubt the advocates of municipal and state ownership will capitalize the misfortune of the privately owned utilities. However, it is not to any lack of foresight on the part of the power companies that the shortage is due.

The Southern California Edison Company, for example, is noted for its enterprise. For the past five years it has been spending from twenty to thirty millions yearly on new developments and extensions. It is a matter of record that the company sought to develop the waters of the Colorado River four years ago and guaranteed, if given a permit, to deliver power from that stream by 1923. Had the company been allowed to do as it wished, there would be ample electricity for all purposes in California today. The Southern California Edison Company cannot do the impossible, however. The water supply is 40 per cent less than the lowest record known to man, and Los Angeles and the vicinity are growing by leaps and bounds. Even with every bit of steam equipment it can command—and it has bought turbine equipment as far away as Cuba—the Southern California Edison Company alone will be more than a hundred million kilowatt-hours short until it can get its new steam equipment on the line and until the winter rains replenish its dried-up reservoirs. As an index of just what such a power shortage means to one company, five million dollars will have to be spent for extra fuel alone by the Southern California company during the emergency.

Although it is unlikely that another such shortage will ever face the power companies of California, the situation reveals certain conditions which need remedying. In the first place, it shows that water-power development is not without hazards and that proper allowances should be made for them; second, it emphasizes the necessity of the early development of the Colorado River, for there is little sense in burning oil when water power is running to waste; third, it indicates to the California Railroad Commission that it must be more liberal in the matter of steam-reserve equipment to guarantee to the users of electricity in California ample power at all times regardless of the winter rains. Cost what it will, no state like California, in which electricity plays such a vital economic part, should

have to face another power shortage like that of this year. While all of the power companies have shown commendable spirit in pooling resources to mitigate the evil consequences of a water shortage equivalent to half a billion kilowatt-hours in five months, it is plainly evident that so long as the Colorado River flows idly into the Gulf of Lower California more steam-reserve equipment must be installed by many of the companies, and slightly higher rates will have to be permitted to maintain this reserve equipment, if it serves no other purpose than to insure against future shortages.

Joint Signal and Supply Poles

FOR many years the necessity of the power companies and the signal companies using the same poles has been recognized not only on account of physical conditions but on account also of economic considerations. The result has been that many of these companies have entered into some form of agreement for joint use of poles or for joint ownership of poles. There have been a great number of agreements made, all different in their nature, and most of them unfair either to one or to the other party entering into the agreement. In order to remove this condition, to assist the various local companies in making agreements and to spare them the expense and time required to work them up, the National Electric Light Association and the Bell Telephone System, it will be remembered, formed a few years ago a joint general committee on physical relations between electrical supply and signal systems. This joint committee has published principles to govern the joint use of poles, and these have met with general approval. They are broad enough to cover nearly all cases. The construction methods recommended are those of the National Safety Code. Although the principles of joint pole use have been established satisfactorily, the more complicated and detailed work of providing a definite form of agreement has not been completed. This work is progressing, and it is hoped that some time in the near future a general standard form of agreement can be proposed for adoption by all signal and power companies.

At present in many places where new agreements are considered necessary the question arises as to just what the companies should do. While in the past no guidance was available on this work, a pretty definite line of action is provided now by the report of the joint general committee. It will be well for the local companies, when agreements are necessary, to see to it that whatever agreement they may enter into does not conflict with the principles that have been adopted by the N. E. L. A. and Bell Telephone System. Local conditions may affect the details of the agreement, but its general lines should not be contrary to the general principles adopted. Any agreement stating principles that do not agree with the joint general work will result in embarrassing the joint general committee and postponing the day when a general form of agreement can be presented to both the power and the signal industries.

In making agreements there are probably three points of chief importance:

1. In the matter of ownership it may be that joint ownership will be found to involve complications in bookkeeping, in valuations and in responsibilities which make it inadvisable. Some experiences indicate that ownership in any pole line should be vested in one or the other company, which would charge a rental for attachments to the other, but in other instances satisfactory joint ownership has been experienced.

2. The matter of setting any voltage limitation for joint use of poles should be avoided, as the character of the circuits and the use of these circuits is what should determine the advisability of joint occupancy.

3. The liability clauses should be carefully considered, as the experience of the past shows that many such clauses are unfair to one or the other party. Though it is evident that in any given case the court ruling will be based on actual responsibility rather than on the accepted liability in an agreement, such unsatisfactory liability clauses may be an unnecessary obstacle to a proper solution of the case at hand.

In proposing any new agreement the power companies and the signal companies should take advantage of their full representation on a very competent joint committee and make certain that they conform to the best information of this committee. Further, they should co-operate with this committee in order to enable it to provide in the shortest possible time a general form of agreement that will be satisfactory to both utilities in all locations.

Why Not Use More Automatics in Mining Service?

THE application of automatic substations to mining service has reached a stage in certain localities which warrants their widespread use. Real pioneering efforts were required to attain this result. On one system, for example, the mine officials opposed the use of automatic substations so strenuously that the central-station company was compelled to guarantee performance and to install complete manual control in addition to the automatic. Now these same mine officials refuse to have any but automatic substations and have eight, which give much more satisfactory service than any hitherto obtained by manual operation.

The reasons for the use of the automatic station can be classed under the general headings of better service and cheaper service. The first cost of an automatic substation is greater than that of the manually operated station, but this cost is more than counterbalanced by savings in performance. Automatic stations for supplying the direct current to large mines can be located at points which reduce line copper costs and line losses to a minimum. It is possible to locate 300-kw. automatic units, for example, at multiple points on a mine property, thus giving better voltage at a less cost than would be possible with a manual station requiring relatively large capacities in order to carry operating labor charges.

Then, again, the service is better from an automatic station because competent attendants for manual stations are difficult to obtain and to keep. It is an unattractive sort of job to attend a small mine substation in an out-of-the-way place, and yet, if intelligent action is to be had in emergency, any conversion station requires a highly trained technical man in charge. Experience has proved, on the other hand, that the automatic equipment will never relax and will remain on the job under all conditions and at all times.

A recognition of the facts about automatic substations in mining service has not been general in the mining industry, but rapid advances have been made recently which indicate a much greater use of these installations in all the mining regions of the country. The pioneering work has been done and accomplished facts are making converts rapidly.

A Notable Electrical Centenary

THOMSON—without the "p" and with it—is a name that shines in modern electrical history. Still doing valiant service for the science and the art are Elihu Thomson of America and Sir Joseph Thomson of England. It is only eight years since Silvanus P. Thompson of the latter country ceased his labors while in the full flood of activity. On Thursday of this week fell the centenary of the birth of William Thomson of Glasgow—better known as Lord Kelvin—whose eighty-three years spanned the period between the early experimental days of Faraday and Henry and the days of fruition that followed the advent of Edison. Combining in unusual degree as Kelvin did powers of mathematical reasoning with the inventive faculty and the manipulative skill of a great experimentalist, his is perhaps the most eminent name of that transition period. Very noteworthy was his work in electrostatics, in thermo-electricity and in galvanometry. His achievements in submarine telegraphy and cables and in the design of electrical measuring instruments are known to all technical students. To him was due the appointment by the British Association in 1861 of its first committee for the determination of electrical standards. His research work was not limited to electrophysics and electromagnetism, but extended into many cognate sciences. He visited America several times, delivered a notable series of lectures at Johns Hopkins University on the wave theory of light and was not only an interested witness of some of the practical translations of theory into practice for which America provided the first theater, but also a valued adviser in making possible their achievement. A few months before his death in 1907 he addressed himself with unflagging zeal to lecturing on the electronic theory of matter. Not only scientists and engineers but all believers in progress and enlightenment may well pause a moment in their pursuits to do honor to the memory of this grand old man of science.

Cable Situation Improving

THE report of the underground system committee presented at the N. E. L. A. convention, of which an extended abstract was published in the ELECTRICAL WORLD for May 24, was devoted chiefly to the cable situation. A frank, definite analysis of existing conditions was made, supported by comprehensive data. The general conclusion was rather pessimistic because the data on both cable and joint failures compiled over a series of years inexorably indicated unsatisfactory conditions. In the opinion of the committee cables have been neither made properly nor installed properly and the fault lies with both the maker and the user. An element in the situation has been the economic pressure to get enough cables to supply the demand and to get them installed quickly, but a more influential factor has been the lack of fundamental knowledge of the proper way to make, install and operate them. Now that the whole situation has been stated and the blame placed on all interested in the cable situation, an encouraging development is occurring. Research work is bringing out the fundamental facts about materials, cable manufacture and joint making. Operating companies have decided to use greater care in inspections and operations, and makers and users of cable are working together to get results for the benefit of all the industry.

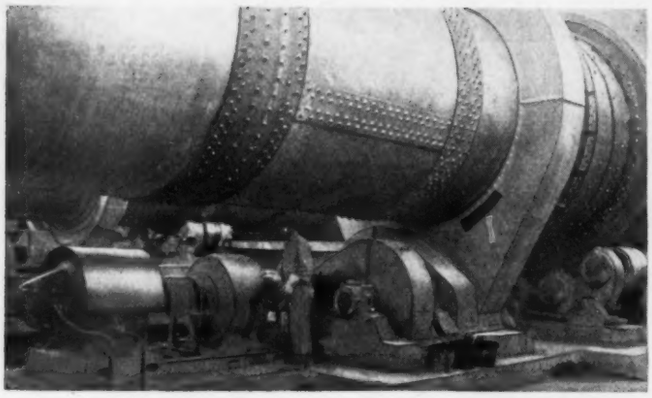
In other words, the problem has been presented clearly and attacked by the full resources of money and brains available; and, though they are difficult to measure, there is no question that improvements have already been made in cables and joints and in cable installation and operation. Until the full answer is obtained, however, unremitting care must be given to existing installations, and new installations should be made with a full realization of all the limitations imposed by the use of a conducting agency that is utterly different from the overhead conductor in its factors of safety and operating characteristics.

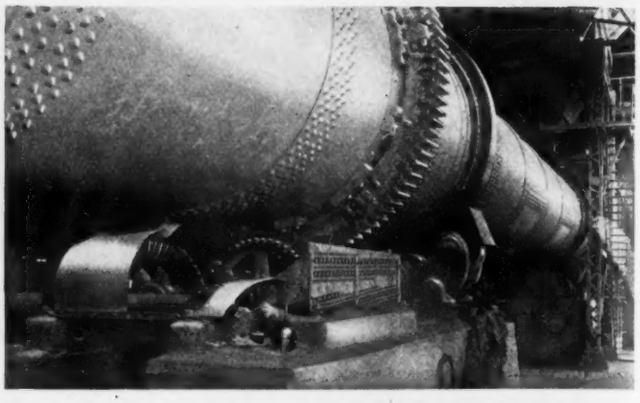
Better Organization of the Electrical Industry

MEN who have observed closely the trend of association activities during the last few years find good evidence that the electrical industry is becoming steadily more helpfully organized. The National Electric Light Association is gradually increasing the responsibilities and activities of its geographic sections so that the individual companies throughout the country are more directly interested and engaged. The executives of the manufacturers have developed a very practical working contact through the Electrical Manufacturers' Council and the Electrical Manufacturers' Club. The Electric Power Club is making real progress with the problems of the motor and transformer builders. There is a sense of unity and common purpose increasingly indicated among the affiliated groups within the Associated Manufacturers of Electrical Supplies. The large growth in the membership of its Radio Section and the earnestness with which the work of establishing policies and standards for this new industry is being carried forward are a fine example of the usefulness of such organized co-operation. The washing machine, cleaner, fixture glassware and credit associations also show advancing strength.

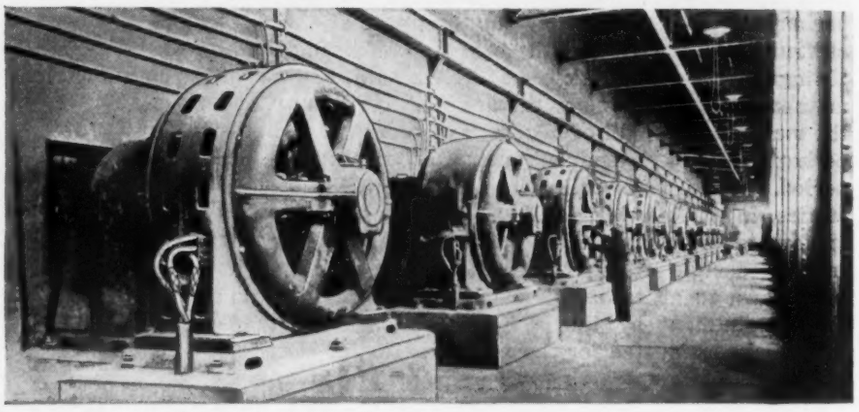
The Electrical Supply Jobbers' Association continues the most constructive influence in the field of distribution, though still representative of too small a proportion of the wholesalers now operating in the industry to make its power for good what it might be. And the same may be said of the Association of Electragists, although this organization has gained notably in the value of its service in the last year or two. There is still an unfortunately large percentage of the contractor-dealers on the outside, however, and the importance of bringing these "outside" jobbers and contractor-dealers into the atmosphere of organized industry thinking was never more pressing than at the present time. To complete the picture, the annual league conference this fall will take action on a plan for the national confederation of local electrical leagues. Meanwhile the Society for Electrical Development has more clearly established itself as the neutral workshop for industry promotion and publicity and has gained greatly in confidence and usefulness.

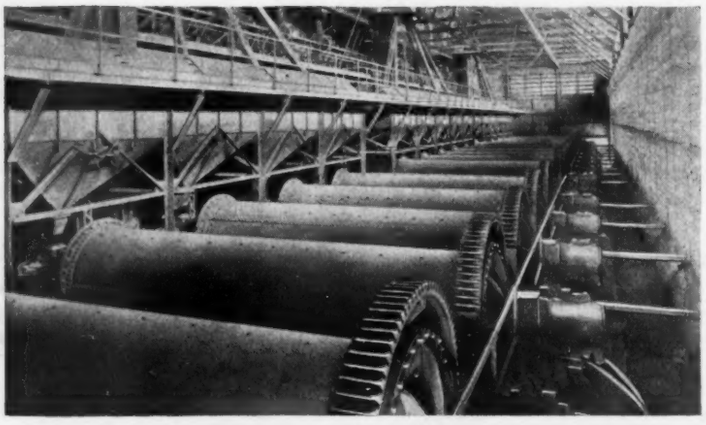
The regrettable resignation of Judge Debevoise as legal adviser to so many electrical associations has drawn to the attention of many who had not thought of it before the extent to which the different branches of the industry are coming to understand each other. The "Judge" was counsel for the jobbers, the Manufacturers' Council, the Manufacturers' Club, the supply manufacturers, the Power Club and the S. E. D. It was a very human bond between them all that has aided no little toward harmony of policy and point of view.





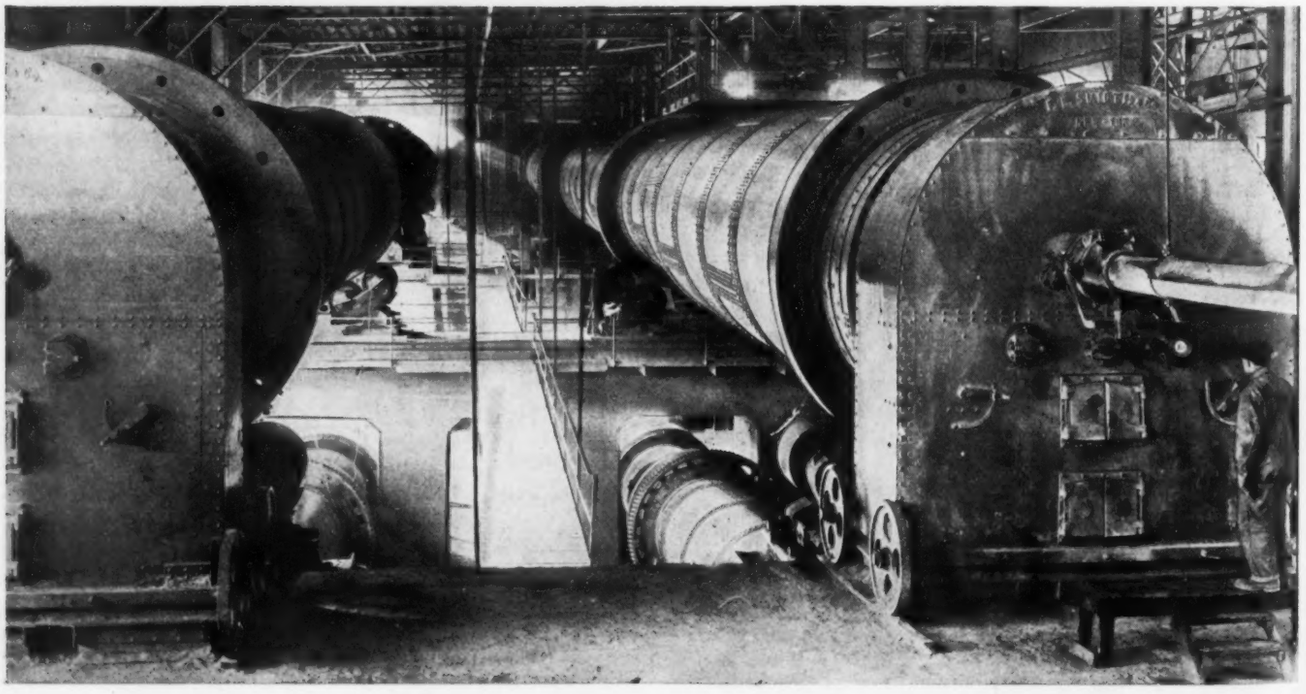
Progress Being Made in the Electrification of Cement Mills in the United States





ELECTRICITY is shouldering a large portion of the work of cement manufacture—an industry which turned out a product of 137,000,000 barrels in 1923. An estimate based on production increases and the installed horsepower in 1919 indicates that there was in 1923 about 550,000 hp. in cement plants, which makes the industry rank tenth. Of this power nearly 40 per cent was supplied by public utility companies.

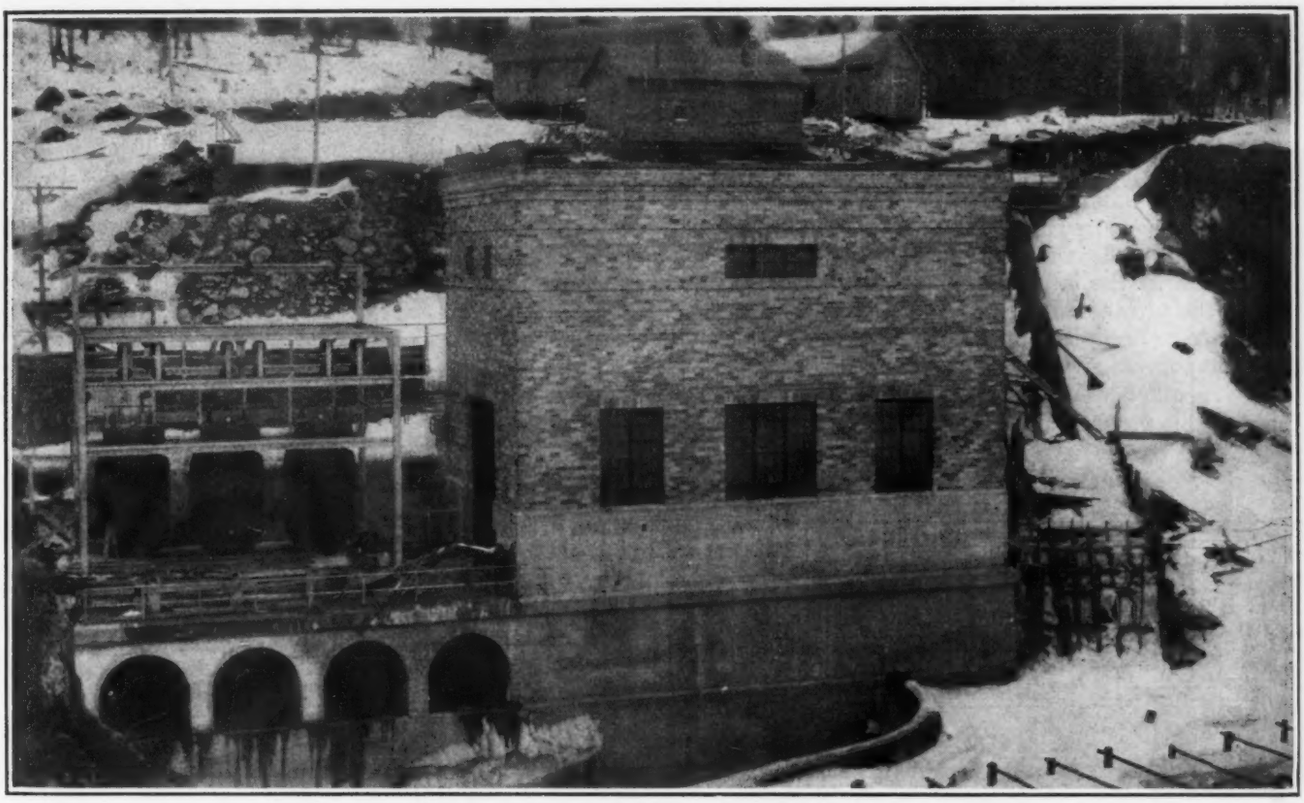
The rotary kilns shown in these illustrations are each 240 ft. long with an interior diameter of 11¼ in. at a distance of 60 ft. from the firing end, where they taper down to 10 ft. and then continue that diameter. They have a capacity of 1,500 barrels of cement per day, and are fired by coal, producing a temperature of 2,800 deg. F. Without brick linings they weigh 675,000 lb. each, or about the equivalent of ten all-steel Pullman cars. To turn this load heavy gearing and motors rated at 150 hp. are necessary. Although most of the motors installed operate 440 volts, there is a growing tendency toward the use of 2,300 volts for newly designed plants. The illustrations also show tube mills with their individual synchronous motors. These tube mills contain steel pellets which grind the raw material into fine powder. Owing to this powder drifting in the atmosphere, the driving motors are installed in another room and the tube mills are connected to them by gears carried through a wall.



A 7,300-Kva. Automatic Hydro Station—I

Sprite Creek Development of Adirondack Power & Light Company Is Fully Self-Operating—Design Details and Method of Protection of This Largest Automatic Installation Are Described

By L. A. WHITSIT
Hydraulic Engineer Adirondack Power & Light Company, Schenectady, N. Y.



SPRITE CREEK AUTOMATIC STATION AND OUTDOOR 66,000-VOLT SUBSTATION

A FULLY automatic hydro-electric station capable of developing 7,300 kva. at 6,000 volts has been installed by the Adirondack Power & Light Company on Sprite Creek, near the mouth of Canada Lake. The site is about 12 miles northeast of Little Falls, N. Y., and the plant is now in operation and furnishing energy to the system.

The most interesting feature of the Sprite Creek development consists in the fact that it is an automatically operated power plant of quite a large capacity. Numerous automatic generating plants have been built in different parts of the country, but only one plant has thus far been put into operation that is of a size comparable with this one. The plant referred to is the Searsburg station of the New England Power Company, which is on the Upper Deerfield River near Searsburg, Vt. Its capacity is 5,000 kva., 60 cycles, and it has a generating voltage of 2,300. The operating head is 210 ft. That particular plant is automatically operated under the joint control of a time switch, a forebay float switch and the transmission-line switch at the receiving station. In other words, the plant will come into operation at a predetermined time of the day provided that the water in the forebay is above a certain elevation and further provided that the energy is desired at the receiving station. The new plant at Sprite Creek will develop 7,300 kva. at a voltage of 6,000 and a speed of 600 r.p.m. It is a 60-cycle plant and has a gross head of 410 ft. and a net head of 370 ft. The power from the Sprite Creek development is being delivered to the Inghams outdoor substation.

The control of the Sprite Creek development is different also from that of Searsburg in that it is placed in operation or shut down simply by closing or opening the high-tension line switch at Inghams. The fluctuation of water level at the intake is not such as to affect its daily operation. The time element is determined at the receiving station, and power may be derived from the station at any or all times during every twenty-four hours.

SEQUENCE OF AUTOMATIC STARTING OPERATIONS

Starting with the condition in which the Sprite Creek plant is shut down, the transmission line switch at Inghams is open, the oil circuit breaker at Sprite Creek power house, which is on the low side of the transformer bank, is open, and there is no electrical energy within the plant. Various relays and mechanical opera-

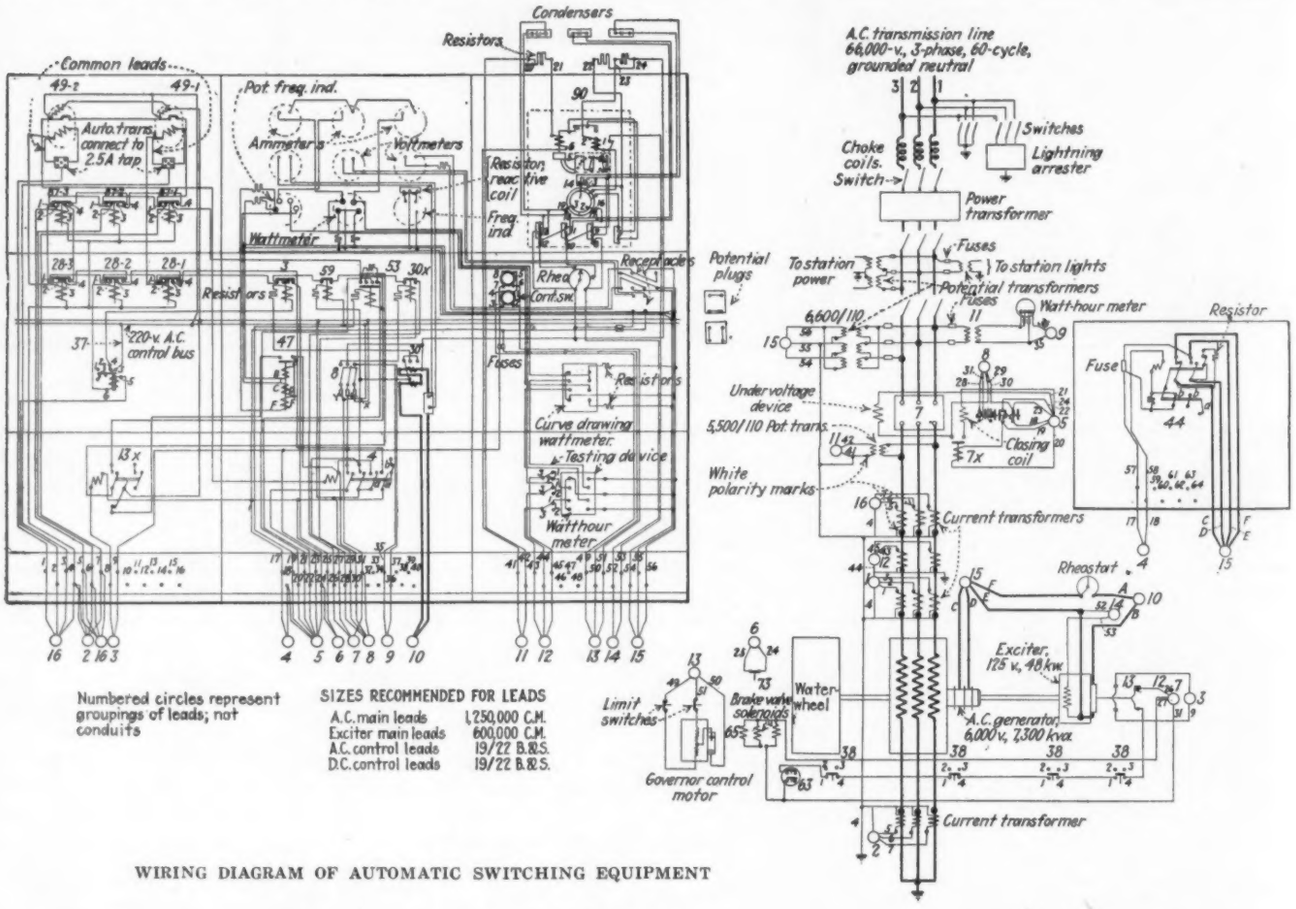
tions are under the control of a 220-volt alternating-current service which is obtained from a potential transformer placed between the large power transformers and the generator oil circuit breaker. When it is desired to start the plant the transmission-line switch at Inghams is closed. This energizes the potential transformer above mentioned and the 220-volt control bus, which results in energizing two alternating-current solenoids, one of which is connected to the pilot-valve mechanism of the governor and the other to an interlock on the turbine-gate mechanism. Energizing the first solenoid places the pilot valve in the opening position. Energizing the second one removes an interlock that has locked the gates in a closed position. At the same time two other solenoids are energized, releasing the water-pressure brakes which have previously been applied. The brakes are under the control of two solenoids which if de-energized admit penstock water pressure to the brakes and if energized close off the water pressure from the penstock and relieve the pressure on the brakes. This particular feature will be described in more detail later.

As soon as the interlock on the turbine gates is released the turbine gates start to drift open because the gates are so designed as to be in a balanced position at part gate opening; that is, at about 0.3 or 0.4 gate opening. In other words, it requires force to open them beyond this position and also requires force to close them from this midway position. The opening force on the gates is that occasioned by the water pressure of 410 ft.

The unit will start to speed up and will increase in speed to a value that is 95 per cent of synchronous speed. The unit thus far in its operation is unexcited, although the exciter is mechanically direct-connected to the turbine shaft and is likewise coming up to speed with its field switch open. When the unit has reached 95 per cent of synchronous speed the relay device will then close the circuit breaker connecting the generating unit with the energized transmission line. The energized transmission line will then bring the unit into synchronism in the same manner as a synchronous motor is started. This operation is followed by the closing of the field switch. The unit is now excited and under governor control and will take the predetermined load at synchronous speed.

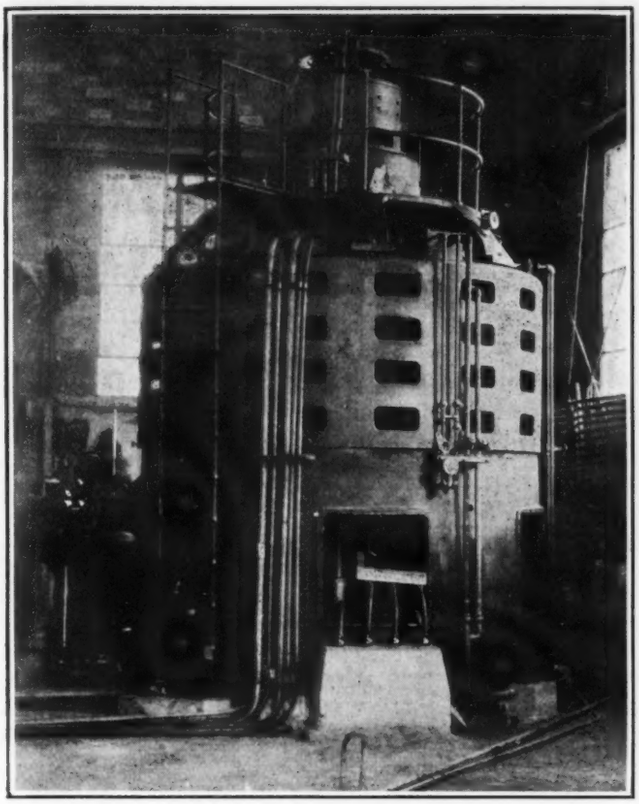
Inasmuch as the intake is at the outlet of Canada Lake, a large storage reservoir, there is in a day-to-day operation of a predetermined load no danger of lowering the water below the intake level as might be the case in a small stream where the intake is supplied only by a small forebay pondage. In the latter case it would be necessary to have a float switch in series with the other master control.

Closing down the plant is accomplished in the following manner: The transmission line switch at Inghams is opened and the load thus reduced to zero.



WIRING DIAGRAM OF AUTOMATIC SWITCHING EQUIPMENT

a—Auxiliary switch, open when main switch is open
b—Auxiliary switch, closed when main switch is open
3—Time-delay stopping relay
4—Master control contactor
7—Oil circuit breaker and mechanism
7x—Auxiliary relay for No. 7
8—Control power switch
11—Control power transformer
12—Overspeed limit switch
13—Synchronous speed-control switch
13x—Auxiliary contactor for No. 13
28—A.C. overload time-delay relay
30—A.C. machine-field relay
30x—Auxiliary relay for No. 30, hand-reset
37—Underload relay
38—Bearing temperature relay, hand-reset
44—Synchronous generator-field contactor
47—Potential reverse-phase relay
49—A.C. machine temperature relay
53—Exciter relay
59—Over-voltage relay, hand-reset
63—Oil pressure relay
65—Governor solenoid
73—Limit switch on wheel gate
87—Machine differential-current relay hand-reset
90—Voltage regulator



7,300-KVA., 600-R.P.M., 6,000-VOLT VERTICAL GENERATOR
Provided with A.T.I. windings in order to secure automatic control.

Under this condition relays open the oil circuit breaker on the low side of the transformer bank and the potential transformer for the 220-volt control bus is de-energized. De-energizing the control bus also de-energizes the two solenoids on the governor, the first of which places the pilot valve for closing position, while the oil-pressure mechanism closes the main turbine gates. De-energizing of the second solenoid is followed by placing the gate interlock in a locked position, thus holding the gates in a closed position whether the governor oil pressure is maintained or not. The closing of the interlock is accomplished by a spring using stored energy which has previously been provided during the opening operation of the turbine gates. De-energizing of the control bus also operates the valves on the water-pressure line to the generator brakes in such a way as to apply the brakes.

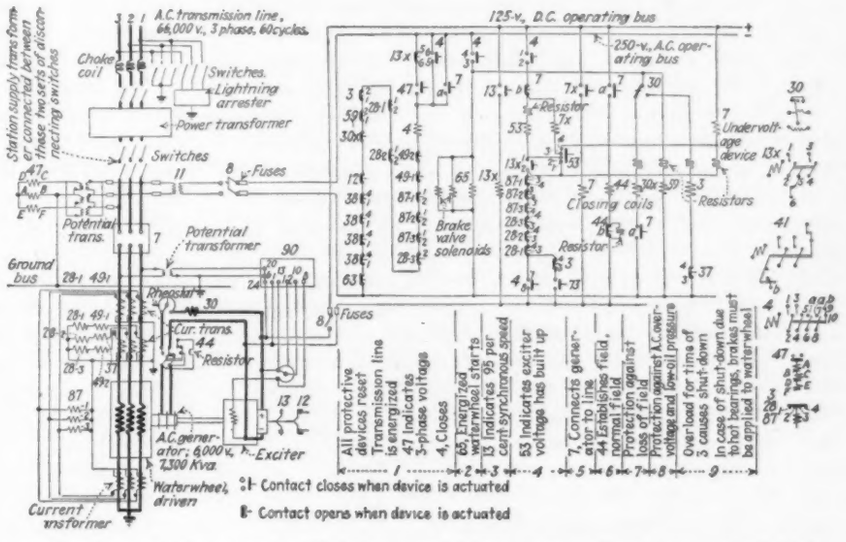
DESIGN PROBLEMS ENCOUNTERED

Some of the problems which came up in connection with this design required a solution different from that which has been utilized in other automatic plants. It is essential to have an oil pressure available in the governor immediately after the unit is started. In the former designs it was necessary to count upon this oil pressure being maintained during the period of shutdown. This is not absolutely assured unless supplied by a pressure-controlled motor-driven oil pump. For this service the motor would require a continually energized transmission line, and this condition would have interfered with the scheme adopted for plant control. It could not be expected that an accumulated oil pressure would hold over during long periods of shutdown and the solution of this problem consisted in utilizing the unbalanced position of the turbine gates and a full penstock pressure for their initial opening. This pressure is always available whenever the unit may be operated. The oil system in the governor is made a closed system without any air cushion and a few revolutions of the main unit create full oil pressure in the governor by the means of a belt-driven oil pump which is self-contained in the governor stand. This scheme, however, permits of a modification to the extent of allowing a small amount of air pressure if it is desired. It does not, however, depend upon this oil pressure being maintained during periods of shutdown.

Therefore, as long as the main unit is rotating there is oil pressure in the governor and the governor will control the unit in such a way as to maintain it at synchronous speed for the predetermined load. In shutting down the unit the momentum of the generator rotor while coming to rest will continue to maintain oil pressure for the closing-down operation.

REASON FOR USE OF WATER BRAKES

In regard to brakes the air type of brake is the most satisfactory. Such a scheme, however, as in the case of the oil pressure, would require a motor-driven air pump in order to insure the maintenance of air pressure for the application of the brakes. This is not feasible without a separate source of power. The solution of this problem consisted in using water pressure from the penstock line for the application of brakes, and this



SCHEMATIC DIAGRAM OF AUTOMATIC SWITCHING OPERATIONS AND EQUIPMENT

a—Auxiliary switch, open when main switch is open
b—Auxiliary switch, closed when main switch is open
3—Time-delay stopping relay
4—Master-control contactor
7—Oil circuit breaker and mechanism
7x—Hesitating control relay for No. 7
8—Control power switch
11—Control power transformer
12—Overspeed limit switch
13—Synchronous speed-control switch
13x—Auxiliary contactor for No. 13
28—A.C. overload time-delay relay
30—A.C. machine-field relay
30x—Auxiliary relay for No. 30, hand-reset
37—Underload relay
38—Bearing temperature relay, hand-reset
44—Synchronous generator-field contactor
47—Potential reverse-phase relay
49—A.C. machine temperature relay
53—Exciter relay
59—Over-voltage relay
63—Oil pressure relay
65—Governor solenoid
73—Limit switch on wheel gate
87—Machine differential-current relay
90—Voltage regulator

water pressure is always available at any time when application of brakes is necessary. It is also always available at any time that the unit may be started. However, water pressure does not possess the elastic feature of air pressure, which is the chief advantage of an air brake, and the elastic feature is accomplished by having the water pressure operate against an air cushion in a closed tank.

In this scheme it is not possible to change instantaneously the amount of load on the generating unit. The kilowatts to be produced must necessarily be predetermined and provided for by a manually operated adjustment on the governor. This may be changed, however, for intermittent periods of a day at the time of the daily inspection of the plant.

Protection Is Fully Provided

There are twenty or more protective relays and devices. For example, the overheating of either of the four main-shaft bearings will shut the unit down. It is then necessary to make an inspection of the unit and to reset the protective relay. There is protection against undervoltage, overvoltage, out-of-phase relation when connecting unit on the line, underload, overload, overspeed, etc. Any trouble of any nature will shut the unit down. In those cases where the trouble may clear itself the unit will come back on; in all other cases the relay must be reset manually, which naturally invites a search for the trouble and its removal before attempting to start the unit again.

Amount of Water Available Determines Output

In the normal operation of the plant its output would be determined by the amount of water available. The water is obtained from Canada Lake, which is a seasonal reservoir for the East Canada system. When the reservoir is full Sprite Creek will be operated on a twenty-four-hour basis in order to avoid wasting water over the diversion dam. During the low-water period of the year, however, the plant would be operated as many hours during the day as would be sufficient to supply the required storage water for the East Canada system (consisting of the Dolgeville plant, Inghams plant and Beardslee Falls plant) at a predetermined load setting. As the maximum kilowatt capacity is usually desired in the daytime during this period of the year the load setting would naturally be the full load of the machine, and in order to furnish the amount of storage water required the operation might extend over a period of four to eight hours out of the twenty-four. At other times of the year, when the reservoir is full, the water which would otherwise be wasted is only sufficient to operate the Sprite Creek plant at full load for a part of the twenty-four hours, say for sixteen hours. These varying operating requirements can be met conveniently by the remote control or automatic features used in this type of plant.

The scheme described above does not furnish any energy for station use, such as lighting and so forth at Sprite Creek, except when the plant is in operation; but inasmuch as the distance from Inghams is only 7.3 miles, it is very probable at some later time a low-voltage circuit will be brought back from Inghams for furnishing such miscellaneous station requirements. If such a procedure is later followed out, a pressure-regulated motor-driven oil pump and a pressure-regulated air pump may be installed. Then if it is also thought desirable to maintain oil pressures and air pressures over periods of sixteen hours of shutdown, the plant may be changed to embody the more usual and normal operating features. In this case the main penstock valve may be motor-operated and controlled by relays in such a manner as to close when the station is shut down. The advantage of this procedure will be in conserving the water leakage through the turbine gates.

Appraisals Based on Number of Meters Connected

Analysis of Cost Estimates on Small-Town Distribution Systems—Limitations and Practical Application of Method

By Reuben B. Sleight
Engineer Minnesota Tax Commission, Minneapolis

How closely may the cost of a small electric distribution system be estimated if the inventory of poles and wire is based upon the number of connected meters? The following discussion will present some figures from actual inventories secured for appraisal purposes which may give a partial answer to the question.

Data are tabulated for seventy villages in the Mississippi Valley and the Great Lake States. The places are average country towns containing the homes of retired farmers, the homes and business places of the merchants of the community and in a few cases small manufacturing industries. In appearance they are much the same. No selection has been made upon the basis of topography or outline of corporate limits. Property owned by nine companies is represented, but probably two or three times as many did the construction work, as a number of the places independently operated in the past have been connected to large systems within the last few years. Some of them were at one time municipally owned, but none is so owned at present.

The tabulated figures are arranged in the order of the number of connected meters in the village. They show two variables of the distribution system, pole-line length and conductor length, in their relation to the number of connected meters. The column headed "Pole-Line Miles" gives the total length of the pole lines of the distribution system carrying primary, secondary and street-lighting circuits, whether one circuit is carried or several. It does not include high-tension transmission lines that may be within the village limits. The column "Conductor Miles" gives the total single-wire mileage of primary, secondary and street-lighting conductors. It includes no services and no transmission. In a few cases a small part of this wire is carried on transmission-line poles going through the village, but the amount is a small percentage.

The data of the first three columns were used to compute the ratios given in the last two. They give "Meters per Mile of Pole Line" and "Meters per Mile of Conductor" figured to the nearest whole number.

At the end of the table (line 71) are the totals and averages for the entire list. The average number of meters per mile of pole line was found to be 48.4, and for each mile of conductor 13.6. As is to be expected, when figured by groups those places with larger loads or with more meters have more connections per mile. Villages with less than 100 meters show 31.1 per mile of pole line and 11.1 per mile of conductor. The averages

for the group made up of communities with more than 300 connections are 52.4 meters per mile of pole line and 14.3 meters per mile of conductor.

When the details are examined the very great range to be found in the number of poles and the amount of wire necessary in systems serving approximately the same number of customers shows up in the two ratio columns. In towns of more than 100 connections meters per mile of pole line go from twenty-eight to eighty-eight, and per mile of conductor from seven to twenty-six.

Experience indicates that the two items, poles and wire, with fixtures and miscellaneous line devices, are most difficult to inventory quickly. The rating of distribution transformers and number of street lamps often can be as readily determined from records as can the number of meters.

The accompanying assumed figures (Table II) will illustrate the application of averages for poles and conductor for an estimate for a 200-meter town.

When the ratio figures of line 73 of the tabulated data are used in computation (average for 100-300 meter places, 50.7 meters per mile of pole line and 13.6 per mile of conductor) there results a total for the distribution system of $12,150. Of this the overhead amounts to $6,100, or 50.2 per cent. If the estimate is based upon seventy meters per mile of pole line and twenty per mile of conductor, the total obtained is $10,338, of which poles and wire make up $4,288, or 41.5 per cent.

TABLE I—RELATION OF CONNECTED METERS TO MILES OF POLE LINE AND MILES OF CONDUCTOR

Line No.	Meters	Pole-Line Miles	Conductor Miles	Meters per Mile Pole Line	Meters per Mile Conductor
1	27	0.3	1.3	90	21
2	34	0.7	1.6	49	21
3	35	0 6	2.8	58	12
4	42	1.1	5.4	38	8
5	42	1.0	3.7	42	11
6	50	1.0	2.6	50	19
7	55	0.9	3.5	61	16
8	64	1.2	6.1	53	10
9	66	0.8	3.9	82	17
10	68	1.8	4.4	38	15
11	68	3.0	9.6	23	7
12	69	1.7	7.7	41	9
13	71	3.2	7.6	22	9
14	73	1.2	4.6	61	16
15	75	2.7	7.1	28	11
16	81	1.4	3.9	58	21
17	84	2.3	11.5	36	7
18	85	1.2	5.6	71	15
19	89	3.2	13 0	28	7
20	89	2.2	10 1	40	8
21	90	1.7	5.7	53	16
22	93	1.8	9.1	52	10
23	103	2.9	13.1	36	8
24	104	1.6	8.0	65	13
25	105	2.1	4.4	50	24
26	109	1.6	6.2	68	18
27	114	2.9	6.2	39	18
28	114	3.0	8.6	38	13
29	113	2.4	11.5	47	10
30	118	3.6	17.2	33	7
31	126	1.5	9.2	84	14
32	128	3.6	16.0	36	8
33	133	2.1	6.3	63	21
34	138	2.1	6.3	66	22
35	144	2.5	11 4	58	13
36	145	2.1	8.0	69	18
37	153	3.0	10.4	51	15
38	161	2.6	13.0	62	12
39	162	3.4	11.2	48	14
40	168	2.4	9.2	70	18
41	174	5.2	15.8	34	11
42	182	3.5	12.7	52	14
43	189	2.2	8.7	86	22
44	189	3.4	10.3	56	18
45	190	4.0	16.3	48	12
46	198	2.9	8.8	68	22
47	203	4.2	13.7	48	15
48	211	2.4	12.1	88	17
49	212	5.1	18.2	42	12
50	230	8.1	26.9	28	9
51	232	4.4	25.4	53	9
52	235	5.7	17.5	41	13
53	251	3.8	17.1	66	15
54	286	3.6	15.7	79	18
55	293	6.9	17.7	42	17
56	312	8.2	25.1	38	12
57	312	7.7	34.8	40	9
58	326	4.8	17.5	68	19
59	385	5.2	17.4	74	22
60	405	6.2	21.3	65	19
61	406	11.4	35.2	36	12
62	433	8.0	27.1	54	16
63	461	8.6	41.9	54	11
64	464	8.6	31.4	54	15
65	477	13.8	48.6	35	10
66	482	10.1	42.3	48	11
67	520	6.6	22.7	79	23
68	535	9.0	20.2	60	26
69	901	17.1	73.1	53	12
70	929	14.9	53.6	62	17
Totals and averages based upon totals, entire list.					
71	14,411	297.7	1,056.1	48.4	13.6
Totals and averages based upon totals, all towns below 100 meters: Nos. 1-22:					
72	1,450	46.7	130.8	31.1	11.1
Totals and averages based upon totals, all towns between 100 and 300 meters, Nos. 23-55:					
73	5,613	110.8	413.1	50.7	13.6
Totals and averages based upon totals, all towns above 300 meters, Nos. 56-70:					
74	7,348	140.2	512.2	52.4	14.3

TABLE II—ASSUMED FIGURES SHOWING APPLICATION OF AVERAGES

Inventory data usually readily secured:	
Number of connected meters	200
Total kva. of distribution transformers	100
Number of street lights	30
Assumed costs:	
Cost of mile of pole line with fixtures, guys, line devices, etc., complete (no conductor) in place	$800
Cost of mile of conductor in place	200
Cost of meter and service in place	20
Cost of distribution transformer per kva. in place	16
Cost of street light in place	15

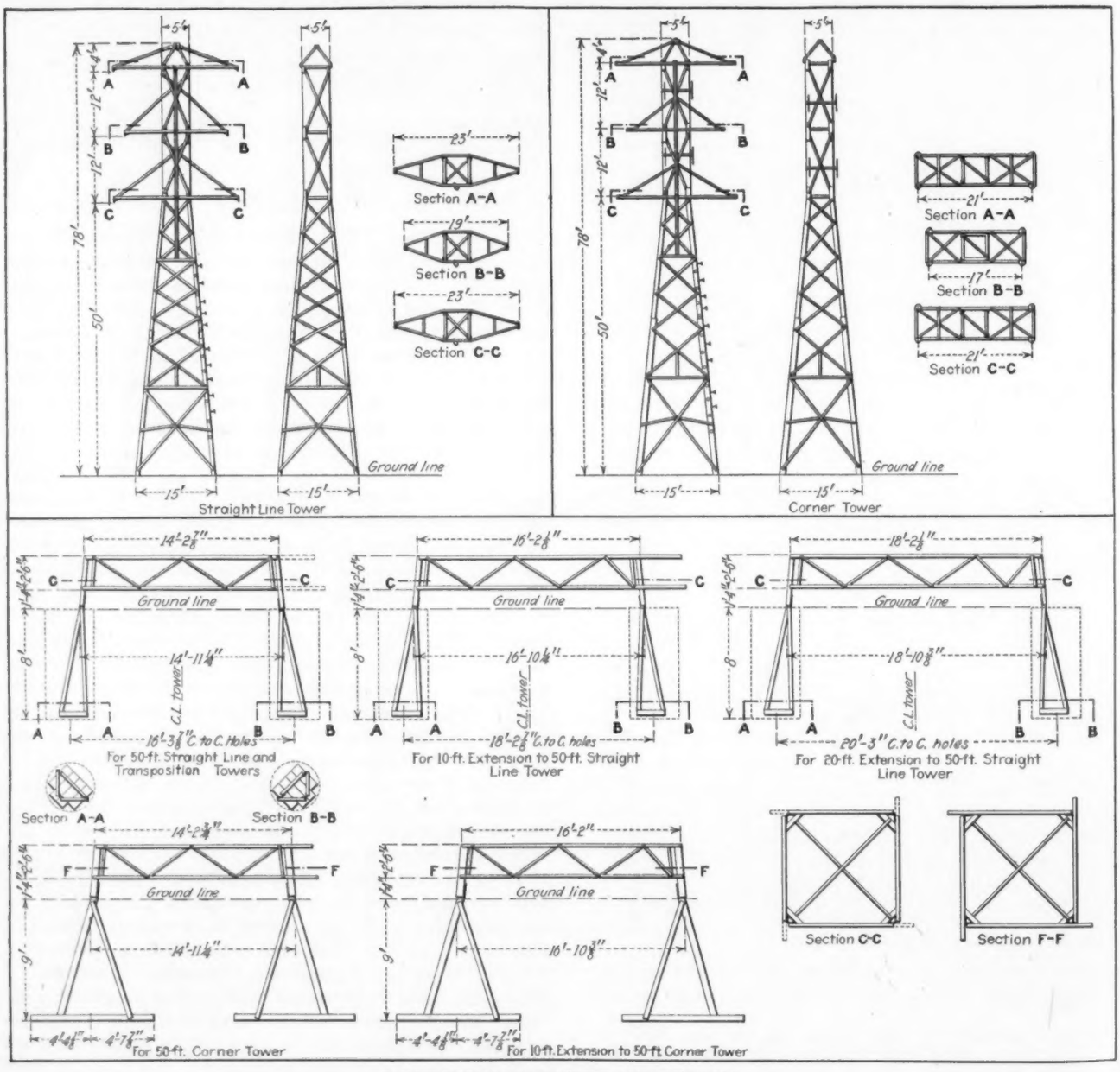
Then going to the other extreme and assuming as the base thirty meters per mile of pole line and ten per mile of conductor, the computed total is $15,483. In this case the overhead classification is $9,333, or 60.2 per cent. The low figure is 85 per cent and the high one 127 per cent of that based upon the averages for 100-300-meter towns in the tabulated data. The range is great, but it is one that might be expected in such an analysis.

Other variables, pole and wire sizes, have not been mentioned. Whether the poles are 25 ft. or 40 ft. (there are a few 40's in the seventy villages) the average spacing has been found to be about the same in the small distribution system. For any one village it requires about the same mileage of conductor whether the system has mostly Nos. 10 and 8 or is largely made up of Nos. 6 and 4. With a general knowledge of the construction standards of a company, averages for pole and wire sizes can be adopted that fit conditions fairly well.

The figures indicate that estimates based upon the number of customers can at best be considered but approximations. The result may be high or low by as much as 35 or 40 per cent for individual towns. The probable error of any total of the estimates for a number of villages, of course, decreases as the number of systems included increases.

There are occasions when some such method as has been outlined must be used for quickly arriving at an approximation of the investment in or cost of reproduction of a property. It can never be recommended when detailed inventory figures are available. However, if the estimates are tempered with good judgment and based upon experience, the results should compare favorably with those of a central-station estimate based upon horsepower or kva. capacity.

NATURE OF RIGHT-OF-WAY, SHOWING TOWER-FOUNDATION CONSTRUCTION FORCES AT WORK



CONSTRUCTION OF TOWERS AND ANCHORS

The lower illustrations show templates and anchors for straight-line corner and transposition towers

Actual Costs of Transmission Line and Substation

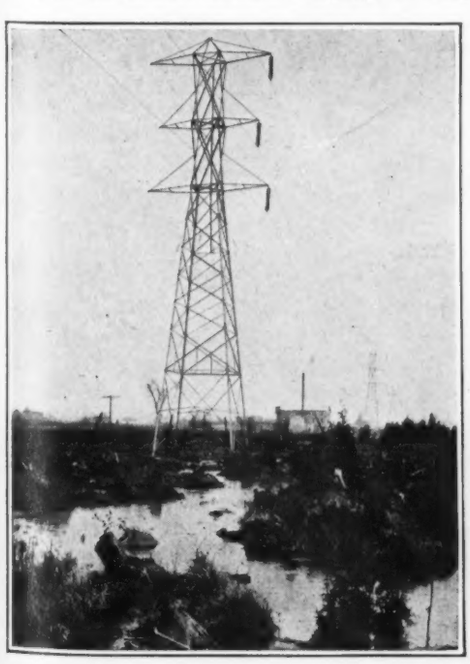
Comprehensive Data on Recently Completed 132-Kv. System in Middle West—Unit Cost of Line $8,830 per Mile—Swampy Land Increased Costs—Details of the Towers and Settings

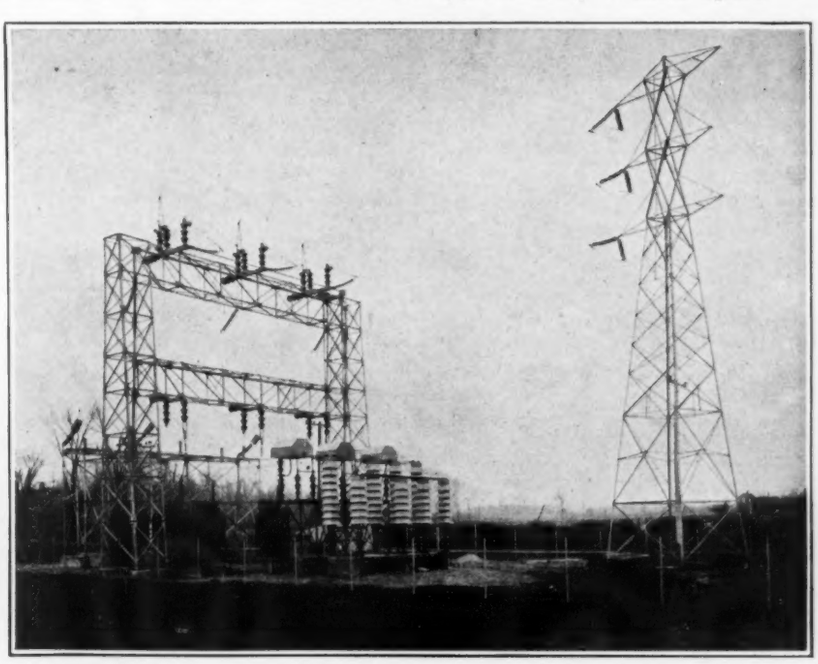
EQUIPMENT and construction costs on two recently erected 132,000-volt transmission line sections and a 132,000/26,400-volt, 3,000-kva. tap substation have just been made available to ELECTRICAL WORLD readers through the courtesy of a company in the Middle West. The cost data which are given below are divided into itemized equipment and construction costs.

The transmission line was built in two sections of 43.9 miles and 30 miles respectively, at an average unit cost of $8,830 per mile, including equipment and labor, but not including interest charges during construction. The right-of-way, which is approximately 80 ft. wide, provides a 10-ft. clearance between the extreme side swing of conductors and the nearest trees or buildings. A portion of the tower line required cutting through woods and setting towers in swampy land, which greatly increased the cost of the work. Tower foundations, where possible, consisted of anchors set 8 ft. in the earth without concrete. In low or soft ground it was necessary to set the foundation anchors in concrete, and in a number of cases it was necessary to keep shoring with timber to prevent the excavation from filling up as rapidly as the digging was done. In a large number of cases pumps had to be operated continuously while foundation holes were dug and foundations poured. The foundation costs were relatively high because special ones had to be installed in the marshy ground.

EXCAVATION AND SHORING REQUIRED FOR TOWER FOUNDATIONS IN SOFT GROUND

Double-circuit towers ranging in height from 50 ft. to 70 ft. to the bottom cross-arms were placed about 600 ft. apart, 357 straight-away towers, seventeen corner towers and ten transposition towers being used in a total distance of 73.9 miles. The majority of the steel towers are 50 ft. in height to the lowest cross-arm, and where higher towers were required a standard tower was extended at the base to give the required height. Corner towers were used whenever the angle in the line was greater than 15 deg., and transposition towers were installed approximately 5 miles apart.





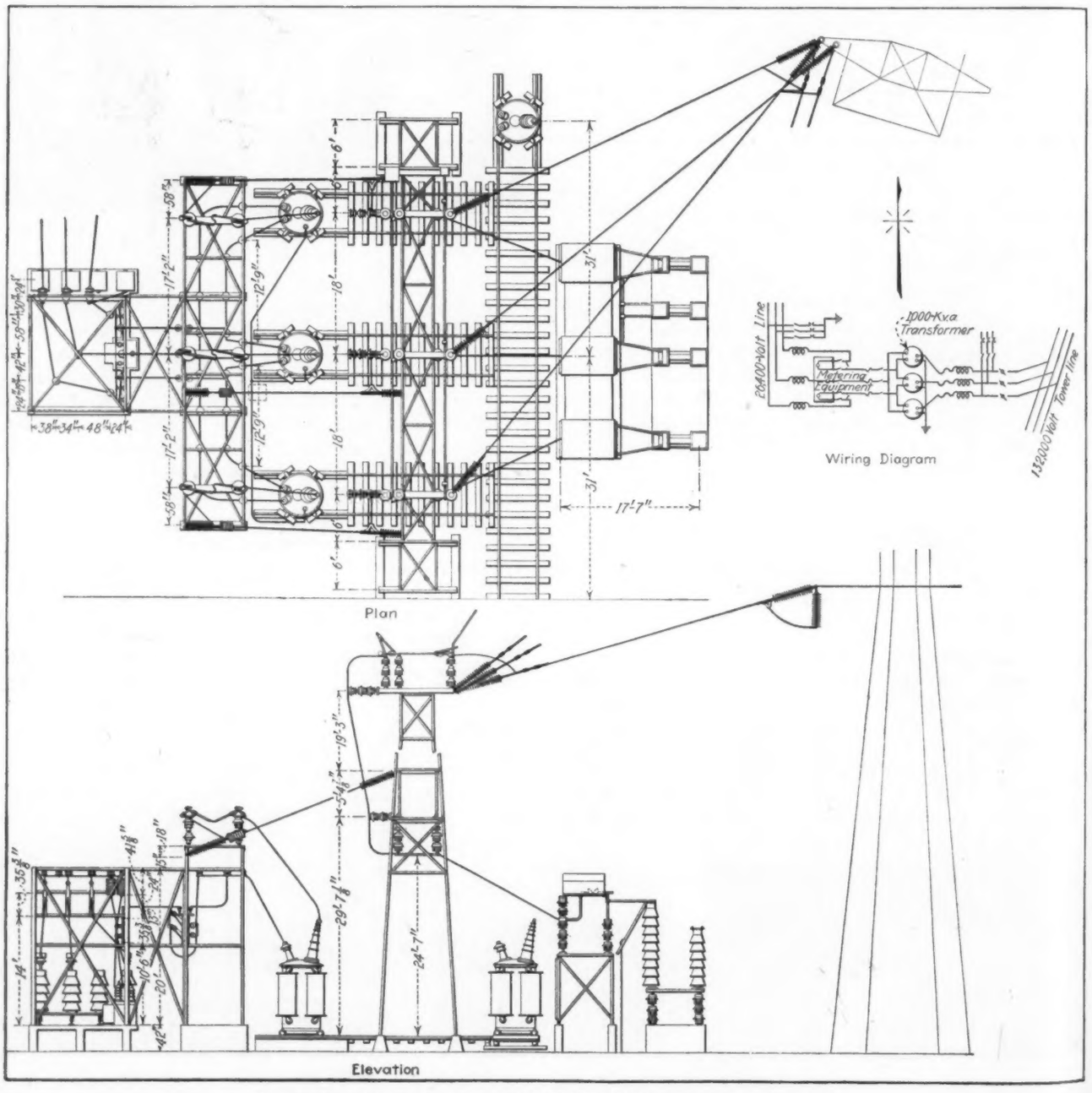
LEFT—RIGHT-OF-WAY ALONG RAILROAD TRACK. RIGHT—VIEW OF 132,000/26,400-VOLT TAP SUBSTATON

Steel for the towers was shipped to the nearest railroad points and from there delivered to the tower locations by means of trucks where possible. In marshy land it was necessary to deliver the towers by truck as close as possible to their ultimate location and then either carry the material or drag it by means of a tractor to the site of the tower. Towers that were erected along the railroad right-of-way were prepared specially for shipment so that all material for a given tower could be unloaded directly from the cars at a point on the railroad right-of-way adjacent to the tower site. By means of this arrangement distribution of tower material was very rapidly accomplished and at a minimum cost.

In all cases towers were assembled on the ground in a horizontal position and then erected by means of a gin pole, block and tackle and a 2-ton tractor. While being raised the towers were steadied by means of rope guys attached to the sides and back.

The towers are designed for two circuits, but insulators are hung on only one side at present, since only one circuit was required initially. No. 3/0 steel-reinforced aluminum conductor is employed, the vertical separation between conductors being 12 ft. Ten disk insulators were installed in suspension strings and twelve in dead-end strings. Wire stringing was started immediately after the towers were erected. Reels of wire were set up along the right-of-way, and the wire was pulled over pulleys attached to the cross-arms. The pulling was done by a 2-ton tractor. The conductors were then sagged and clamped to the insulators.

Among the major items of expense, the cost of towers and erection constituted 39 per cent of the total, conductors, insulators, hardware and stringing 22 per cent, right-of-way easements and clearing 18.1 per cent, foundations and footings 16.7 per cent, hauling, unloading, engineering and supervision 4.2 per cent. The ratio of labor expense to equipment cost is interesting,



PLAN AND CROSS-SECTION OF 132,000/26,400-VOLT TAP SUBSTATION

BILL OF MATERIAL FOR SUBSTATION

Item No.	No. Required	Description
1	1	Lightning arrester, G. E. Co., three-phase, 60-cycle, 132,000-volt, type of form BQ
2	4	Transformers, Allis-Chalmers Co., single-phase, 60-cycle, 76,300/27,600-volt
3	1	Pole switch, R. & I. E. Co., 132,000-volt, 400-amp., type V-3
4	3	Disconnecting switches, 132,000-volt, 400-amp., single-pole
5	3	Fuses, Westinghouse, 132,000-volt, 300-amp.
6	10	Disconnecting switches, 26,400-volt, 300-amp., single-pole
7	1	Metering unit, Westinghouse, three-phase, 60-cycle, 26,400/110/55-volt, 25/50-amp.
8	1	Lightning arrester, G. E. Co., three-phase, 60-cycle, 26,400-volt, type of form BO
9	3	Disconnecting switches, G. E. Co., 37,000-volt, 300-amp.
10	3	Fuses, S&C, 100-amp.
11	6	Choke coils, Westinghouse D-9, 200-amp. (236447)
12	6	Insulators, stock, R. & I. E. Co., 132,000-volt (OB)
13	231	Insulators, suspension type (OB 25622)
14	8	Insulators, vertical type (OB 11622)
15	2	Hydro grounds for items Nos. 1 and 8
16	1	Plate ground for item No. 2
17	9	Suspension eyes (OB 13499)
18	25	Suspension-wire clamps (OB 11540)
19	9	Ball-socket eyes (OB 11544)
20	6	Suspension strain-wire clamps (OB 11949)
21	40	Eye nuts, L. M. Co., ¾-in. bolt (1737G)
22	3	Cable connector drills for No. 4/0 stranded wire
23	10	Cable connector drills for No. 2/0 stranded wire
24	170 ft. app.	No. 4/0 stranded wire, bare
25	6	Ball-socket clevises, M. I. (OB 11545)
26	290 ft. app.	Z stranded wire, bare
27	12	Groove clamps, A. C. of A., with copper bushing (153)
28	31	Suspension hooks (OB 13394)
29	226 ft.	No. 3/0 wire
30	546½ ft.	8-in. cyclone fence
31	90 ft.	No. 4/0 solid wire
32	3	No. 1/0 jumpers, 8 ft. long

COST OF 132,000-VOLT STEEL TOWER LINE

Single-circuit No. 3/0 aluminum-conductor steel-reinforced on double-circuit towers

Material	Cost	Cost per Mile
Right-of-way (easements for 386 towers)	.....	$1,168
Supports (galvanized-steel towers spaced 8.75 per mile)	.....	2,560
325 50-ft. straight-line towers	$91,000	
30 60-ft. straight-line towers	9,780	
2 70-ft. straight-line towers	714	
13 50-ft. corner towers	5,876	
4 60-ft. corner towers	2,072	
9 50-ft. transposition towers	2,619	
1 60-ft. transposition tower	339	
Footings and guys	.....	121
Deadman anchors and guys	289	
Cement, gravel and lumber for swamp foundations	5,309	
Conductor No. 3/0 A.C.S.R., 169,725 lb	.....	791
Insulators, suspension type 13, 336, at $2.33	.....	707
Line hardware	.....	94
Wire clamps for No. 30 A.C.S.R., 1,059, at $1.82	1,918	
Strain clamps for No. 3/0 A.C.S.R., 233, at $6.50	1,514	
Suspension hooks, 1,285, at 35 cents	450	
Parallel grooved clamps, 230, at 85 cents	198	
Splicing sleeves, 160, at 21 cents	34	
Labor and Sundries		
Clearing right-of-way		244
Installing foundations		1,181
Assembling towers		311
Erecting towers		165
Stringing wire		130
Unloading and hauling		80
Engineering and supervision		240
Total cost (not including interest during construction)		$8,830

COST OF 132,000/26,400-VOLT, 3,000-KVA. TAP SUBSTATION

(Interest during construction not included)

Land and Structure		
Land	$200	
Rails, 6,000 lb. at 1.5 cents	90	
Structural steel, 28,000 lb., at 6.5 cents	1,820	
Concrete (including reinforcing steel)	1,044	
Fence, 560 ft. erected	739	
Transformer transfer cars, two, at $229.50	459	
Miscellaneous material	73	
		$4,425
Equipment		
Four transformers, 76,300/26,400-volt, 1,000-kva.	$21,000	
One 132,000-volt oxide-film lightning arrester One 26,400-volt oxide-film lightning arrester One 132,000-volt air-break switch, 400 amp. Three 132,000-volt disconnecting switches, 400 amp. Three 132,000-volt fuse switches, 300 amp. Three 26,400-volt liquid fuses Six choke coils, 200 amp. Six 132,000-volt insulator stacks Thirteen 26,400-volt disconnecting switches	15,175	
Miscellaneous material		
		36,175
Labor and Sundries		
Foundation and structures	$3,500	
Installation of equipment	2,000	
Engineering and supervision	500	
		6,000
Grand total		$46,600

being about 21 per cent for right-of-way, 19 per cent for towers, 8.90 per cent for foundations and footings and 8.2 per cent for wire, insulators and stringing.

The tap substation consists of three 1,000-kva., 132,000/26,400-volt oil-cooled transformers together with necessary switching equipment and lightning arresters on both the 132,000-volt and the 26,400-volt side. This substation is approximately one mile from the nearest railroad station, and arrangements were made to have the transformers and equipment delivered by train to a temporary unloading platform built along the railroad right-of-way near the substation. The equipment was unloaded on this platform and then skidded over to the substation site and placed upon the foundation.

Data on the substation are divided into land and structure expense, equipment cost and labor and sundries expenses, each classification being itemized. Of these expenses, land and structures cost 9.6 per cent, equipment 77.6 per cent and labor and sundries 12.8 per cent of the total expense, which was $46,600 exclusive of interest charges. Structural steel and concrete, including reinforced steel, constituted 41 and 23.6 per cent of the land and structural expense. The transformers represent 58 per cent of the equipment cost, while all other equipment constituted only 42 per cent. The labor cost on foundations and structures was about 79 per cent of the land and structure investment, whereas labor expenses on installing the equipment was only about 18.2 per cent of the equipment cost.

Electrical Power in the Savoie

ALTHOUGH the sources of electrical energy are plentiful in the French Alps, it is surprising to find that very few of the townships in the Savoie Department are electrified. This is explained by the great distances to the distributing centers, situated in the mountains, and to the lack of available power in reserve. The Forges et Acieries P. Girod, at Ugine, Savoie, have made a request for a concession which is at present under consideration. They would make use of the important hydraulic falls of the region of the valley of Doran de Beaufort and the Lake of Girotte, situated about 50 km. from the county seat of the department, where the center of the tramway system will be. This system is now in course of construction and will be completed in a comparatively short time.

The city of Chambéry, the capital of Savoie, has associated itself with the proposed plan for the supply of electric power for tramways. The city would make use of the reserve power from the Forges et Acieries concession for the public transport service and the lighting of Chambéry by constructing a line whose cost would be diminished by this concentration of power. The department has planned two transformer substations on the line Venthon-Chambéry. The first one, now in course of construction at Buisson-Rond near Chambéry, will serve principally the needs of the city and the tramway system. The second substation will be erected at Saint Pierre d'Albigny and will supply the intercommunal syndicate of Beauges, which consists of thirteen communes, and was formed to enable these districts to have their own electrical lighting and power.

It would also supply another intercommunal syndicate of eleven communes on the left bank of the Isère, organized for the same object, and lastly an electric motor car which will run between Saint Pierre d'Albigny and Les Beauges. This line will eventually be extended as far as Aix-les-Bains through the Beauges district and a part of the Haute Savoie.

The communes which the Venthon-Chambéry line will cross are considering the project, and it is expected that the Department of Savoie will soon obtain the ratification of the concession for the distribution of electrical energy that will be so beneficial for the countryside. There are at present many projects on foot in the Savoie for the harnessing of waterfalls, erection of new plants and the installation of distributing centers for electrical current and information has just been published regarding those that are about to be realized.

The Société de Transport d'Energie des Alpes, uniting ten important companies, with the central office in Lyon, will insure the distribution of electrical power produced by hydraulic plants chiefly in the Savoie region. The concession has already been presented to the Minister of Public Works to construct an interdepartmental distributing center which would supply the following: (1) A group of feeders connecting several plants in the Alps with connecting points near Albertville, Montmelian and Chambéry; (2) three lines going from these points to a central post at Bron, near Lyon, and passing by Montmelian; (3) various feeders in the vicinity of Lyon going from the post at Bron to the post of the Société Hydro-Electrique de Lyon at Lyon-Mouche, the post of Vaulx-en-Velin and to the plant at Cusset; (4) a line connecting the post at Bron with Villefranche; (5) a union of lines from the post at Bron to Givors, Rive-de-Gier, Saint-Chamond and St. Etienne. The company has also considered a line connecting Montmelian with Beaumont-Monteux, following the valley of the Isère. As their present finances do not permit of the immediate construction of this line it was not included in the request for the concession.

The communes crossed by this projected system number about 102 in Savoie, thirty-three in Isère, one in Haute-Savoie, twelve in the Rhone, nine in the Ain and twelve in the Loire. The feeders at Lyon will be equipped for 10,000 volts. Each of the three elementary lines will be designed for the transmission of 35,000 kw. in normal functioning. The plants united by this proposed system represent a total power of more than 550,000 kw., of which 100,000 is generated by coal and the rest by water power.

Among other requests for concessions is the one made by the Société de la Haute-Isère for the harnessing of the upper Isère, at a cost of 40,000,000 francs. The falls of less importance will be utilized according to the law of Oct. 16, 1923, notably at Chapelle-en-Maurienne, where the commune has already procured the authorization to establish this system for electrical distribution.

At Saint-Jean-d'Arvey the mountain torrent of La Doria will be confined and utilized in two separate places to generate power for various communes of the region. The request for this concession has just been granted. This will permit of the distribution of electricity to the mountain districts to Chambéry that are not on the main lines Venthon-Chambéry or Haut-Gresivaudan.

The Compagnie Savoisienne d'Electricité, Paris, has obtained authorization to divert the waters of the Meline for a hydro-electric plant to supply power for lighting the commune of Yenne and neighboring townships, and to supply some small factories of the region.

Business Activity Slightly Below Normal During May

FIGURES upon which the "ELECTRICAL WORLD Barometer of Business Conditions in the Electrical Industry" are based indicate that during May activity within the electrical industry was for the first time since September, 1922, below normal.

A decrease of 3.0 points on the barometer scale, as compared with April, is shown. During the interval the industry has grown 2.3 points, making a net decrease in activities of 5.3 points on the barometer scale as compared with April. The electrical industry as a whole was operating during May at 4.2 points or per cent below what would have been the point of seasonal demand if growth in the industry had been normal. In April it was operating at 1.1 points or per cent above the point of normal demand.

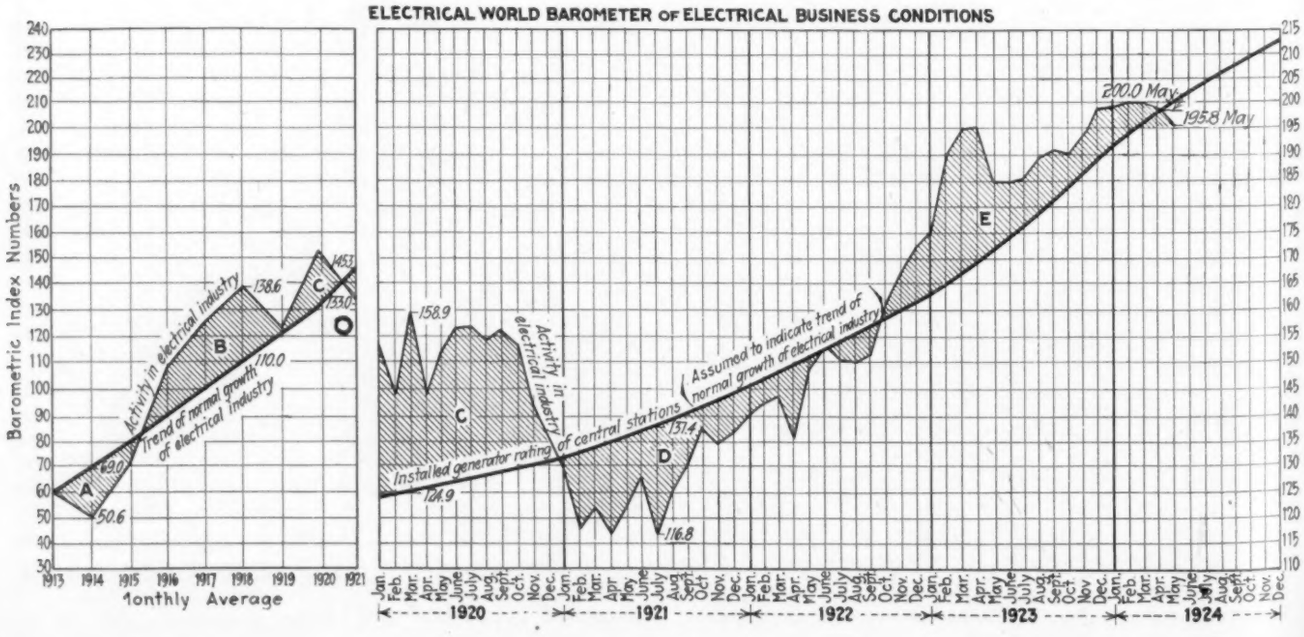


FIG. 1—ROANOKE YARD AT NIGHT APPROACHES DAYLIGHT VISIBILITY

Floodlighting Railroad Yards

Adoption of This Practice Has Materially Increased Operating Efficiency and Safety on Norfolk & Western Railroad—Details of Installation —Costs and Operating Results

By E. G. McALLISTER
Assistant Electrical Engineer Electric Service Supplies Company, Philadelphia

FLOODLIGHTING as a means of illuminating large areas came into rather widespread use during the war period and was particularly effective in providing illumination for night operation in the fields of industrial operation and construction work. This type of lighting also found wide application in protecting vital industrial plants and structures during that period. Its application to railroad yards, however, has heretofore been rather limited and largely experimental in nature.

The Norfolk & Western Railroad has made a complete installation covering the entire system, providing floodlights for railroad-yard illumination at fifteen main terminal points. This installation was carefully planned and is very effective. Yard conditions vary considerably with traffic requirements, and the floodlight locations and illumination intensity values were chosen in such manner as best to meet local requirements.

There are a number of factors of importance in lighting railroad yards, of which, perhaps, the first is to be found in reducing damage to freight and equipment caused by rough handling. This sort of damage to freight amounted to approximately 17 per cent of the total freight claims paid by the railroads in 1922. Definite figures as to reduction in losses of this character that may be effected by the installation of floodlighting are not available, but expressed opinions by the members of the American Railroad Association's committee on freight claims prevention, based upon operating experience with yard lighting of this character, are to the effect that such freight claims undergo a very material reduction which is directly traceable to the more effective illumination produced by floodlamps. Another consideration of major importance is to be found in the better working conditions and the consequent improvement in safety standards thus made possible. Night operations are also found to be speeded up, and a greater volume of traffic is handled in a given time than was possible with the older types of arc or incandescent lighting systems. Losses chargeable to pilferage are also materially reduced because of the higher illumination levels obtained and the greater protection to property afforded thereby.

DESCRIPTION OF INSTALLATION

The installation made by the Norfolk & Western Railroad consists of type FL-1419 floodlights mounted on suitable platforms built on 70-ft. steel towers. The towers were supplied by the Bates Expanded Steel Truss Company of Chicago and consist of six standard 35-ft. poles assembled in two sections, the lower section using four of the standard poles and the upper section using two. These sections are joined by riveted butt plates, and the two sides of the tower, comprising two standard 35-ft. pole sections at the bottom and one at the top, are suitably spaced and tapered by means of a rugged angle-iron construction. An angle-iron platform is built on the top of the tower which provides mounting facilities for a maximum of twelve floodlights. Access to this platform is provided by ladder spurs built on one corner of the tower.

Each tower is set on a reinforced-concrete foundation, 7 ft. long, 6 ft. wide and 7 ft. 6 in. deep, secured

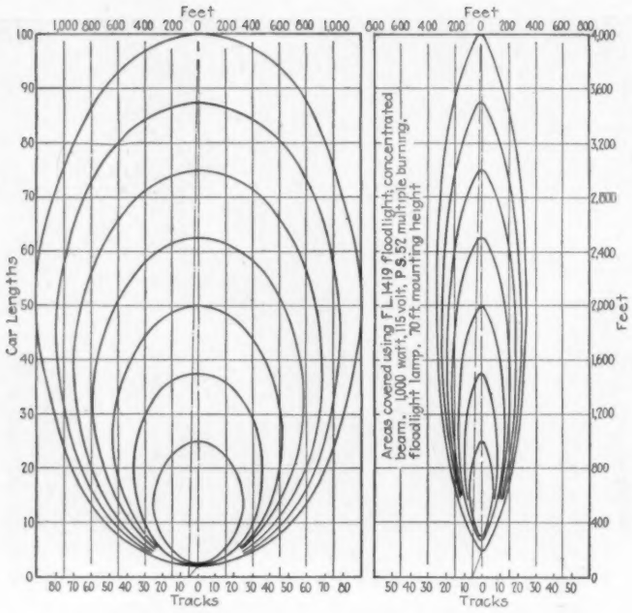

Feet
Car Lengths
Tracks
Areas covered using FL-1419 floodlight, concentrated beam, 1,000 watt, 115 volt, PS-52 multiple burning, floodlight lamp, 70 ft. mounting height
Feet

FIG. 2—LIGHT DISTRIBUTION CURVES FOR FLOODLIGHTS USED

1,500-watt, 28,950 lumens; 1,000-watt, 19,300 lumens; 750-watt, 13,900 lumens; 500-watt, 7,020 lumens. Lamps burned with tip down and distribution curves taken on a horizontal plane 100 ft. from the projector.

by eight foundation bolts, 1 in. in diameter, in four groups of two bolts each. Each group of bolts is joined at the bottom by a steel plate 18 in. x 12 in. x ¼ in. in size. The tower foundation was so dimensioned that the structure would not be blown over by a fifty-mile wind, with the entire foundation above ground. The tower foundations were installed with approximately 6 in. of the foundation projecting above the ground line. The towers are placed at points where space was available and from which floodlighting may be directed with most advantage. Each tower is provided with a transformer of suitable size which is fed from a 2,300-volt primary line. In all cases the distribution line used with the older system was retained and adapted to supply energy for the floodlamps. On the distribution line pole from which the transformer primary is fed a 2,300-volt primary fuse block is mounted. The secondary line from the transformer is controlled by a safety switch mounted at the transformer. The line from the safety switch to the tower platform is run in conduit to a distribution box where there are individual switches controlling each light.

TABLE I—COMPARATIVE COST ANALYSIS

Two 3,500-Ft. Yards—Receiving and Classification

The floodlighting installation assumed consists of five 70-ft. steel towers, each having mounted thereon four type FL-1419 floodlights using 1,000-watt, 115-volt PS-52 standard multiple burning lamps.

The pendent-unit installation assumed consists of standard-type "Novalux" units mounted on 25-ft. poles spaced 125 ft. apart; lighting units spaced 250 ft.; one string of lights down each side of each yard, lights staggered.

Material	Floodlights Quantity	Floodlights Cost	"Novalux" Quantity	"Novalux" Cost
Poles	56	$280.00	112	$560.00
Towers assembled	5	1,275.00	.....	.....
Wire	14,000 ft.	280.00	14,000 ft.	280.00
"Novalux" units complete	.....	.....	56	2,636.00
Projectors and lamps	20	1,000.00	.....	.....
Hardware fittings line	.....	84.00	.....	168.00
Floodlight transformers (5-kw.)	5	410.00	.....	.....
Circuit-panel-switchboard	.....	150.00	.....	150.00
Tub transformer	.....	.....	50 kw.	1,140.00
Switches, conduit and wire towers	5	200.00	.....	.....
Foundation—towers	5	400.00	.....	.....
Total material	.....	$4,079.00	.....	$4,930.00
Labor				
Setting poles	56	$336.00	112	$672.00
Erecting towers	5	750.00	...	.....
Stringing wires	14,000 ft.	28.00	...	28.00
Framing poles	56	56.00	112	112.00
Hanging "Novalux" units	.....	.....	56	280.00
Installing transformer	.....	.....	...	25.00
Installing circuit panel	.....	25.00	...	25.00
Building tower foundations	5	975.00	...	.....
Total labor	.....	$2,170.00	...	$1,142.00
Incidental and shop expense and overhead, at 25 per cent	.....	542.50	...	285.50
Total labor and overhead	.....	$2,712.50	...	$1,427.50

	Floodlights	"Novalux"
Total material	$4,079.00	$4,930.00
Total labor and overhead	2,712.50	1,427.50
Total cost	$6,791.50	$6,357.50

"Novalux" Performance and Operation Costs

Fifty-six form No. 1 "Novalux" units using 1,000-cp. series lamps will deliver approximately 1,300 lumens each, effective up to 80 deg. from vertical, assuming 60 per cent light effective in yard proper, other 40 per cent on right-of-way.

Total lumens delivered, 72,800. Assuming the yard to be 200 ft. wide, or approximately 1,400,000 sq.ft. in area, the average effective illumination intensity will be 0.05 foot-candle.

Assuming a power cost of 1.75 cents per kilowatt-hour, a 365-day year and ten-hour darkness, the power consumed will be 134,904 kw.-hr. and will cost $2,360.82 per year.

Series lamps of 1,000 cp. are rated at 1,000 hours' life and carry a net price of $6 each. A 365-day year, with ten-hour darkness, results in a renewal factor of 3.65 per light in service per year. Fifty-six lights in service will require 204 lamps per year and will cost $1,224 per year for renewals.

Floodlighting Performance and Operation Costs

Twenty FL-1419 floodlights using 1,000-watt, 115-volt multiple lamps will deliver approximately 6,500 lumens each, effective, making the total lumens delivered 130,000. With the 1,400,000-sq.ft. yard assumed, the average effective illumination intensity will be 0.093 foot-candle.

With a power cost of 1.75 cents per kilowatt-hour, a 365-day year and ten hours' darkness per day, the power consumed will be 73,000 kw.-hr. and will cost $1,277.50 per year.

Multiple lamps rated at 1,000 watts, 115 volts have 1,000 hours, life and carry a net price of $5.50 each, and a renewal factor of 3.65 for twenty lights will require seventy-three lamps per year and will cost $401.50 per year for renewals.

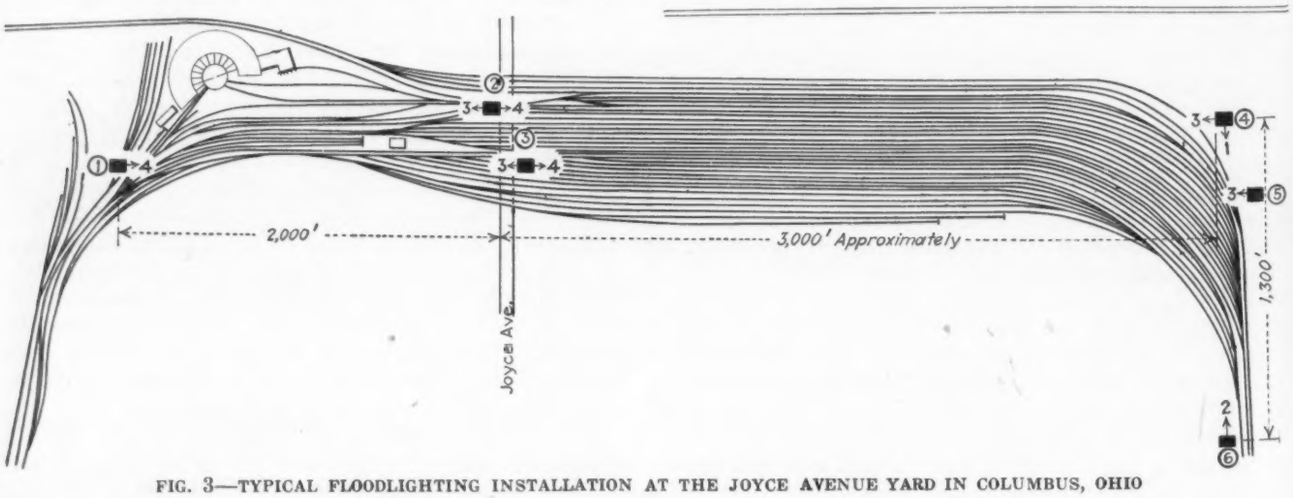


FIG. 3—TYPICAL FLOODLIGHTING INSTALLATION AT THE JOYCE AVENUE YARD IN COLUMBUS, OHIO

This enables independent focusing and training of the lights.

The entire installation, comprising fifteen main terminal points, used approximately seventy steel towers of the kind described above and about 350 floodlights. In a few cases floodlights were installed on top of a coal wharf or other high building.

Advantages of Flood Lighting

It is confidently asserted that floodlighting offers the best solution to the railroad-yard lighting problem that is at present available. The installation cost of a floodlight system is in general about the same as that for an installation using large pendent units according to the usual practice. The light distribution obtained is vastly better and the illumination levels are raised several hundred per cent. Power consumption may be reduced and maintenance cost is greatly lowered by reason of the units being installed in groups.

Floodlighting is particularly effective in that the beam from each unit is trained at a small angle to the horizontal and can cover a large area with a very uniform illumination. The rails stand out sharply owing to reflection of the light from their polished surfaces, and the ends and sides of cars are illuminated to best advantage since the light is directed almost normal to their surface. Car numbers can be easily read from a considerable distance in any part of the yards. The absence of glare and the elimination of lighting units mounted at low levels, combined with background illumination of moderately high intensity and with sharp contrasts, enables excellent judgment of distance and provides a long range of vision. The net result is a close approximation to normal daylight operating conditions.

It is to be noted that damage to freight and equipment caused by rough handling is in almost every case due to imperfect judgment of speed and distance on the part of the car rider. The higher illumination values and more effective light distribution obtained by floodlighting aid him in more accurately determining these factors. It is also interesting to note that dwarf signals are generally clearer and that head-lantern signals are much more easily discernible with floodlamps than is the case with the older arc or incandescent lighting systems. It is more or less common for an engineer to find a hand-lantern signal from a switchman obscured by the glare from an arc or incandescent lighting unit behind and in line with the switchman's lantern. This condition does not exist in yards having a properly installed floodlighting system.

The entire absence of glare in the line of normal

FIG. 5—A VIEW OF TOWER AND FLOODLIGHTS IN ROANOKE YARD

FIG. 4—ANOTHER VIEW OF ROANOKE YARD

vision permits location of floodlight towers without regard to position and visibility of automatic signals. This condition is largely controlled by the tower height and is of major importance.

An interesting result of the application of floodlighting to one yard is found in a material reduction in the time required to handle the usual traffic. An installation has been in operation at this point for something

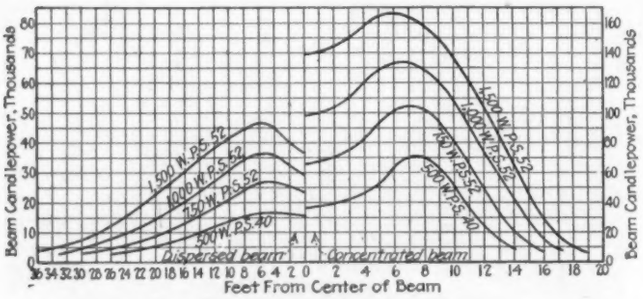


FIG. 6 (LEFT)—THE DISPERSION BEAM OF A 1,000-WATT FLOODLIGHTING LAMP IN TERMS OF AREAS COVERED. FIG. 7 (RIGHT)—THE CONCENTRATED BEAM OF A 1,000-WATT FLOODLIGHTING LAMP IN TERMS OF AREAS COVERED

more than three years. Prior to the installation of floodlighting the second shift generally finished making up its trains at about 1 o'clock in the morning. Since the installation of floodlighting this work has been finished between 10 p.m. and 10.30 p.m., and this increased speed in handling, which has existed over a long period, cannot reasonably be ascribed to any other cause.

DISCUSSION OF COSTS

Figures are given in Tables I and II showing comparative costs for a floodlighting installation and a pendent-type series incandescent lighting system. It is to be noted that illumination levels are several times higher with floodlamps than those obtaining with the pendent-type installation. The first cost for floodlights is slightly higher in the estimate, but the annual savings effected by their use are large enough to pay for the entire installation within a comparatively short period. The actual economies effected by floodlighting, together with the material advantages already outlined, indicate that it is eminently suitable for railroad-yard lighting and that large operating economies are to be obtained by its use.

Light-distribution curves showing the candlepowers for the FL-1419 "Golden Glow" floodlighting unit, using 500, 750, 1,000 and 1,500-watt, 115-volt standard lamps, are given in Fig. 2.

A typical installation is shown in Fig. 3. Tower locations are noted and the number of floodlights used is shown. The general directions in which the floodlights are trained are indicated by the arrows. These drawings are not to scale, but, in general, towers are placed from 2,000 ft. to 4,500 ft. apart, the distance depending, of course, upon local conditions and lighting requirements.

The areas covered by the useful portion of the beam from the type FL-1419 unit used are shown in Figs. 6 and 7. In developing these diagrams a mounting height for the projector of 70 ft. and a 1,000-watt, 115-volt PS-52 multiple-burning floodlight lamp in the projector were used. The two diagrams show approximately the maximum dispersion that can be obtained without employing auxiliary dispersion devices, as well as the maximum concentration that can be obtained. The diagrams are drawn to a scale of 400 ft. to the inch. Tracks indicated are assumed to have 13-ft. centers and car lengths to be 40 ft.

CONCLUSIONS FAVORABLE TO FLOODLIGHTING

In general, the results to be obtained from a properly designed and adequate floodlighting installation approach normal daylight operating conditions closely. In this and every other respect floodlighting has amply demonstrated its marked superiority over any of the other methods available for lighting railroad yards which have been used in the past.

Reproductions of unretouched photographs that were taken in the West Roanoke yard are shown. They indicate definitely some of the advantages to be obtained by the proper installation of floodlights.

Rigid Underground Cable Operates at 100,000 Volts

AN EXPERIMENTAL high-voltage underground cable for transmitting power at 100,000 volts was recently demonstrated by an electrical concern near Berlin, according to the *Elektrotechnische Zeitschrift* for January 10, 1924. In this cable the conductors are separated from each other by insulating spacers, placed within a steel tube, which is slotted its full length. Through this slot the molten insulating compound is poured into the tube. After vacuum treatment a strip of steel is welded over the slot to close it. The cable is made and shipped in lengths of 45 ft. The ends are conically flared out and are to be connected with cable junction boxes of only 8 in. length. At corners a steel elbow is substituted for the straight tube. The inventor claims that for equal copper cross-sections this new cable costs only one-half as much as a similar lead-sheathed cable. Whether such a cable would be practical would depend largely upon the behavior of the insulating compound under the influence of temperature changes and its ability to maintain a certain elasticity. Other elements to consider are associated with practical difficulties of installation and maintenance.

TABLE II—SUMMARY OF YEARLY OPERATION COSTS

	Floodlights		"Novalux"	
	Amount	Charges	Amount	Charges
Interest on investment	$6,791.50, at 6 per cent	$407.49	$6,357, at 6 per cent	$381.45
Renewal lamp cost	73, at $5.50	401.50	204, at $6	1,224.00
Power cost, at 1.75 cents per kw.-hr.	73,000 kw.-hr.	1,277.50	134,904 kw.-hr.	2,360.82
Maintenance	73, at 1.00	73.00	204, at $1	204.00
Depreciation, material and labor construction	$5,651.50, at 5 per cent	282.58	$3,441.50, at 5 per cent	172.80
Depreciation, material and labor, per light units	$1,140.00, at 10 per cent	114.00	2,916.00, at 10 per cent	291.60
Annual charges itemized above		$2,556.07		$4,634.67

Annual saving effected by use of floodlights, $4,634.67 — $2,556.07 = $2,078.60
Annual saving effected in per cent of floodlight installation cost, $2,078.60 ÷ $6,791.50 = 30.55
Time required to pay floodlight installation cost from savings effected, 100 ÷ 30.5 = 3¼ years approximately.

Letters from Our Readers

A Place Set Apart for Suggestions, Comments and Criticisms, to Which All Men of the Electrical Industry Are Cordially Invited to Contribute

Errors in Relay Settings Caused by Phantom Load

To the Editors of the ELECTRICAL WORLD:

The article by W. S. Schmidt in the March 15 issue of the ELECTRICAL WORLD on "Errors in Relay Settings Due to Phantom Load" well indicates the errors which occur when phantom load is used. I think the article by R. H. Andrews in the June 21 issue gives considerably more light on the subject and at the same time supplements Mr. Schmidt's article.

Mr. Schmidt apparently blames the phantom load for the peculiar performance of the relay. Of course, this is not true, or the phantom load could not be used for meter calibration. Mr. Andrews conclusively proves that the distortion is inherent in the relay and that with the phantom load the distortion is not eliminated. Mr. Schmidt in his oscillograms I believe has shown line voltage when picturing the effects of resistance loads. This apparently is where he got the idea that the distortion is caused by the phantom load. Had he pictured the voltage across the relay he would have noted very different results.

This iron saturation is apparently introduced as the most convenient method of obtaining a definite time limit, although it does cause difficulty in calibrating. Calibration curves may be obtained experimentally and applied to any given phantom load for a particular type of relay.

R. G. WARNER,
Assistant Professor of Electrical Engineering.
Sheffield Scientific School, Yale University.
New Haven, Conn.

Urges Fundamental Changes Rather than Mechanical Modifications

To the Editors of the ELECTRICAL WORLD:

Mechanical considerations usually constitute the deciding factors in the design of large generators for power stations because their characteristics are largely determined by the prime movers to which they are connected, as, for example, engine types, waterwheel generators, turbo-generators, etc. However, most other types of rotating electrical machines, and especially industrial motors, are characterized chiefly by their electric and magnetic features. Thus the various types of motors, such as shunt, series, compound, single-phase and polyphase induction motors, etc., are distinguished by the methods in which the electric and magnetic circuits of the machine are disposed relative to one another. In view of this the really forward steps in the evolution of industrial motors have been those modifications which materially affect the electric and magnetic conditions; yet these are few in number compared with the very great number of purely mechanical modifications. The electrical and mechanical characteristics being based on more or less obscure phenomena, of which there are only indirect evidences, must be determined mathematically, and there is a strong tendency to avoid them in favor of structural changes that can be observed directly.

In the general arrangement of its electric and magnetic circuits the induction motor has remained essentially the same for twenty-five years or more, while innumerable changes have been and are being made in the mechanical features. The most notable developments resulting from modification of the stators are the two types known to all users and manufacturers of induction motors as the riveted type and the cast-frame type. As both types are being successfully manufactured by a large number of companies, it may be assumed that economically the difference between them must be small, and no discussion of their relative merits is intended. What it is desired to emphasize is that the importance of choosing between the two is often greatly overestimated.

Still stronger evidence of most engineers' preference for mechanical rather than electrical improvements is found in the great variety of squirrel-cage rotors on the market, differing from each other mainly in the methods of fastening the bars to the end rings, as, for example, riveted and soldered, silver-soldered, brazed, cast-on, welded, wound with copper strips without joints, made of one sheet of copper with one joint, etc. The last mentioned appears to have some disadvantages from the designer's standpoint. For mechanical reasons the slot must be deep and narrow, while in many cases a wide and shallow slot may result in a much better performance. Furthermore, the end rings and bars being of the same material, the designer is not at liberty to distribute the rotor losses in the manner often found desirable in high-resistance rotors for intermittent service, such as elevators.

Real progress in the mechanical construction of squirrel-cage rotors would therefore appear to be in advancing the art of joining metals, both similar and dissimilar, rather than endeavoring to avoid joints.

In marked contrast to the kind of improvements just mentioned is the unity-power-factor synchronous-induction motor recently put on the market. The inventors and the company they represent deserve great credit for going beyond merely minor structural modifications and offering a solution of the problem of power-factor correction by directing their attention to more fundamental changes of design. Whether or not their motor is the best solution of this problem is beside the point. In fact, the writer believes it possible to obtain equally good results by more economical methods. However, the point to be emphasized is that if some of the energy and ingenuity now expended on mechanical features were devoted to modifications similar to those embodied in the motor mentioned, much more rapid advance of the art would probably result.

K. L. HANSEN.
Milwaukee, Wis.

Ozone Detrimental to Phenolic Materials

To the Editors of the ELECTRICAL WORLD:

In the ELECTRICAL WORLD for September 15, 1923, page 544, there is a table accompanying an article on the properties of insulating materials in which the effect of ozone on phenolic insulating materials is tabulated as "not known." As we have been in the ozone business for about fifteen years, we feel obliged to let you know that the effect of ozone on phenolic materials is detrimental. Neither pure bakelite nor any of its compounds, such, for example, as the well-known "pertinax," withstand ozone for any longer time than a few hours up to a few days. Creeping discharges (10,000 volts) cut canals and, through carbonization, cause short-circuiting.

A. VOSMAER.
Ozon Maatschappy "Odrie,"
The Hague, Holland.

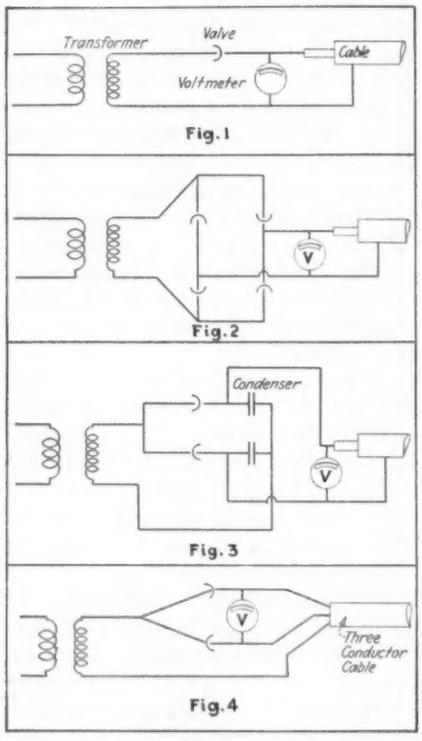
Central Station and Industrial Practice

Installation, Operation, Maintenance, Test and Repair of Generation and Distribution Equipment, and Methods of Economically Utilizing Electric Service in Large Industrial Plants

High-Pressure Testing of Underground Cables

By C. G. Watson
Engineering Department
Duquesne Light Company

WHEN voltages were low and cable route lengths short, there was little difficulty to test a completed line for pressure, but as voltages and lengths increased greater trouble was experienced in pressure-testing a cable simply by connecting it across the terminals of a step-up transformer, for in order to cope with the capacity current of the cable such transformers became exceedingly unwieldy and costly to transport to the site of the test.



FIGS. 1 TO 4—TESTING CABLES WITH HIGH-TENSION DIRECT CURRENT

To overcome the difficulty of the large wattless current taken in testing, inductances were connected in parallel with the cable under test; but this did not greatly alter the weight of the testing apparatus, for the bulk of the inductance more than made up for the reduced size of the step-up transformer. Another method tried was to use a specially designed transformer of low power factor, so that the leading power factor of the cable was balanced by the lagging power factor of the transformer; but this method was not so successful in practice as it had been hoped and its development was not proceeded with.

Then came the method, introduced by Delon, of testing with direct current, and this radically reduced the weight of the apparatus and the cost of testing. At first the direct current was obtained by the use of an electrically synchronized mechanical rectifier and a small transformer, but with the coming of the kenotron tube the mechanical rectifier was superseded, and nowadays high-tension direct-current testing of cables is accomplished in one of the following ways:

1. The most simple case is shown in Fig. 1, where the secondary of a step-up transformer of a small capacity is connected in series with one valve and the dielectric of the cable to be tested. However, the direct voltage obtainable in this way is only equal to the peak value of one-half of the alternating-current wave.

2. To utilize both halves of the alternating-current wave, four valves can be connected in the way that was in use more than twenty years ago for small electrolytic rectifiers. The details of this method are shown in Fig. 2.

3. Another method by which both halves of the alternating-current wave can be utilized without the need of more than two valves is shown in Fig. 3. In certain cases this method requires the use of auxiliary condensers.

4. In the case of a three-conductor cable or three single-conductor cables, the use of two valves, as in Fig. 3, but without auxiliary condensers, enables both halves of the alternating-current wave to be utilized. Fig. 4 shows the connections for this method.

Some Synchronous-Motor Applications

IN THE minds of many engineers there yet remains doubt as to the proper use of synchronous motors. To allay this doubt the Electric Machinery Manufacturing Company, Minneapolis, has produced the accompanying chart showing when these motors can be used in the various industries. For every black circle there is a proper application of synchronous motors. This chart should be of great assistance to central-station power salesmen in converting their prospective customers to this type of drive.

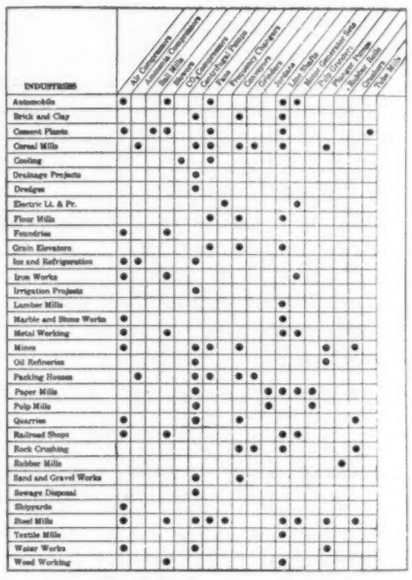


CHART FOR THE READY DETERMINATION OF SYNCHRONOUS-MOTOR USE

Compressed Air Replaces Steel Tape in Ducts

AS A FURTHER step in the interest of safety, the Kansas City Power & Light Company in pulling cables through ducts no longer runs a steel fish line through first, in order to determine clearance. This method has been found entirely too dangerous, especially in ducts carrying high-tension cable, since the tape may come dangling out in

an unexpected place perhaps dangerously near a high-tension line.

Instead of the former method the company now makes use of a ball of string blown by compressed air which is piped to many parts of the Northeast power plant. On underground construction work the compressed-air tank used in tearing up pavements is available as a means of energy. By this method there is no danger to workmen even should the string be blown through the wrong conduit.

Improving Directional Relay Operation

BY A. H. SWEETNAM
Assistant Superintendent Electrical Engineering Department
Edison Electric Illuminating Company of Boston

THE Edison Electric Illuminating Company of Boston has found it desirable in the operation of its transmission system to adopt definite minimum, inverse-time-limit overcurrent and power-directional relays in order to obtain selective operation of oil circuit breakers in case of line fault. A typical section of the system, showing generating station, substations and transmission lines, is represented in Fig. 3. Energy is delivered to the transmission system at generated potential, nominally 14,000 volts. The generators are star-connected with the neutral grounded through a resistor limiting ground-fault current to approximately 2,000 amp. Generators are protected against internal failure by means of differential relays, and the transmission lines are each equipped with three current transformers used for indicating instruments as well as relays.

Owing to the nature of the territory served and the location of the load centers, it is necessary to supply substations in tandem, in one case as many as five substations being served by a pair of lines. From this it will be evident that attempting to obtain selective operation of oil circuit breakers by means of a time interval between adjacent relays involves a long time setting on the relays at the generating station. After a long series of tests it was decided to use a time interval of 0.3 second between adjacent relays. By careful calibration and selection of individual relays this small interval has proved practicable.

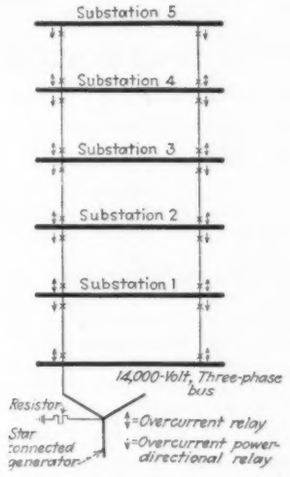


FIG. 3—TYPICAL PAIR OF TRANSMISSION LINES FEEDING SUBSTATIONS

The standard method of installing a set of three single-phase, overcurrent, power-directional relays involves the use of three current transformers and two potential transformers in open delta. This method is also applied to the use of one three-phase, power-directional relay and three single-phase, overcurrent relays. A study of the standard wiring diagram (Fig. 1) shows that the failure of one high-tension potential transformer fuse will leave potential on the potential element of each relay, but that the resultant torque (due to disturbed phase relations of current and potential) on one of the three relays will cause the directional element of this relay to close its contact, although the direction of energy flow has continued normal. Should this occur at time of current in excess of the current setting of the over-current element due to line fault beyond this relay, an incorrect relay operation would result; in fact, this has occurred. With this possibility of incorrect operation, the following solution was adopted (Fig. 2):

Method of Overcoming the Difficulty.—(1) Three potential transformers with the secondaries in closed delta; (2) six primary fuses, one in each high-tension lead to a transformer; (3) a 15-watt pilot lamp placed directly across the secondary of each potential transformer before establishing the low-tension delta connection; (4) a single-pole

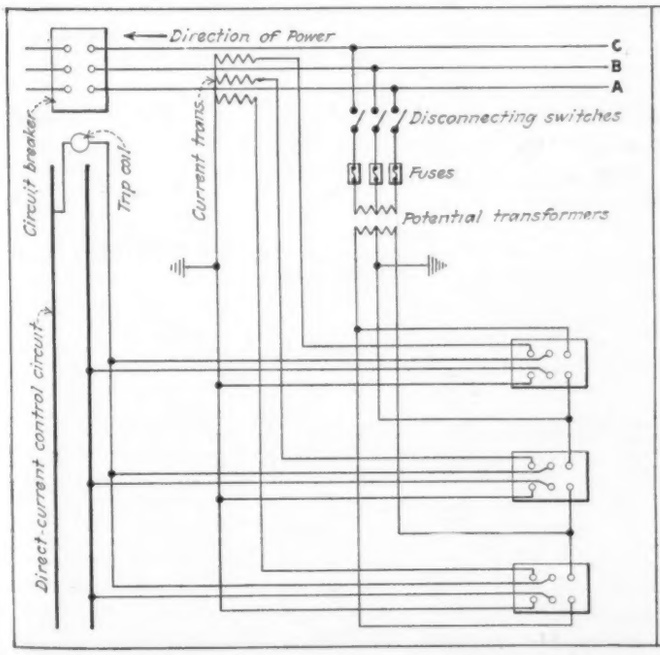


FIG. 1—PREVIOUS STANDARD RELAY CONNECTIONS FOR OVERCURRENT POWER DIRECTIONAL ACTUATION

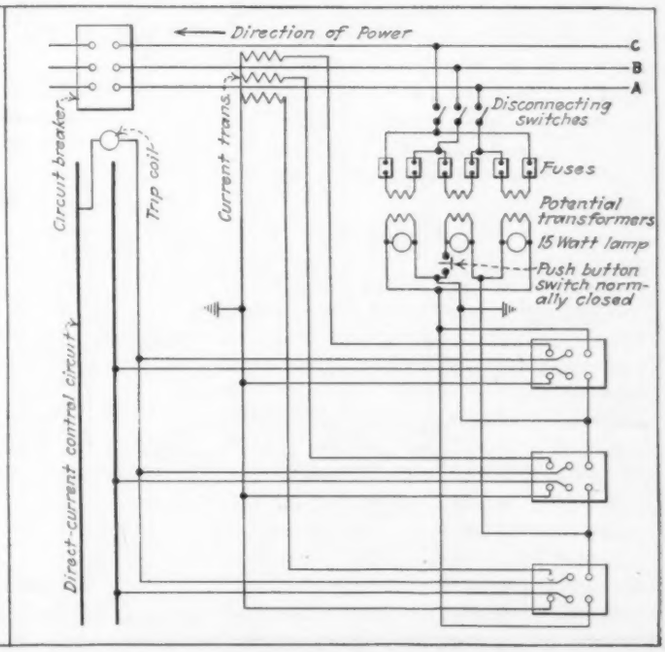


FIG. 2—IMPROVED CONNECTIONS ADOPTED WITH THIRD POTENTIAL TRANSFORMER

(normally closed) switch in the low-tension delta; this should preferably be of the push or pull type so that when the handle is released the circuit will automatically be closed.

A study of this method of connection shows that the failure of one high-tension fuse will leave normal current and potential relations on each relay and all pilot lamps burning, but the failure of a second fuse in one of the other two potential transformers would result in incorrect relay action if the current setting of the overcurrent element were exceeded as in the case of a line fault beyond the particular relay affected. With one high-tension fuse blown the operation of the circuit-opening switch will cause one pilot lamp to lose its source of potential. By means of a periodic test a station operator can assure himself that the relays are functioning correctly.

The frequency of testing for fuse continuity can be made anything considered desirable by the operating executive. In our case the test interval is eight hours. At each change of watch the operator taking charge and the operator being relieved go to the panel on which pilot lamps and test switch are installed. The test switch is manipulated and each operator observes the pilot lamps. If each lamp burns normally with the test switch open, fuses are known to be intact. If one lamp loses its source, the primary fuses of the potential transformer are replaced and the test repeated.

A considerable number of installations as above described have been in service for approximately two years with invariably correct functioning of relays.

Overhead Distribution Construction

Standardized Practice as Developed and Used by the
WEST PENN POWER COMPANY, PITTSBURGH

Clearances for Joint Pole Construction

For vertical runs of two or three wires of the same circuit on insulators, standard twisted, multiple-cable wire shall be used, as shown in Figs. 65 and 66. Such multiple-conductor wires shall be tied to the insulators with heavy marlin cord and never with a metallic tie wire. Vertical runs of primary conductors may be made with metal sheathed cable and inclosed within a conduit of suitable insulating material for their entire length, except that where more than 6 ft. below the lowest telephone attachment iron pipe may be used. Such conduit and pipe shall be securely fastened to the pole.

No ground wire shall ever be attached to any telephone ground wire, ground clamp or rod. In general, ground wires should not be run on the same pole as telephone ground wires or telephone connections to underground wires.

Pole-type transformer installations on joint poles shall be mounted one gain position below the lowest crossarm carrying line conductors. Installations greater than one 50-kva. or three 15-kva. transformers on joint poles require special construction and shall be referred to the distribution engineer in each case. On joint poles the secondary racks shall be mounted below the transformers and shall have a minimum clearance of 12 in. from the bottom of the transformer or its hangers.

Street-lamp installations may be made upon joint poles as shown in Figs. 65 and 66. No street-lamp fixture or brace or guy from a street lamp shall come within 24 in. of any telephone crossarm or line conductor. The vertical clearance between lamp fixtures and suspension wires carrying telephone wires or cables shall be not less than 12 in. Where practicable, telephone cable terminals shall be not less than 12 in. vertically from the fixture, but when this clearance cannot be obtained all metal parts of terminals shall have the greatest practicable separation from lamp fixtures, including all supporting screws and bolts of both classes of attachments.

Switches, cut-outs, meter boxes and similar apparatus may be installed on joint poles at a height convenient for operation, provided they do not interfere with climbing space or with vertical runs. All such apparatus, if located below telephone attachments, shall be of a type in which all live parts are covered and protected from accidental contact, as shown in the illustration Fig. 67.

All joint poles which carry vertical wires or cables, branch cut-outs, transformers, street lamps, meters or other attachments that require frequent attention shall be stepped.

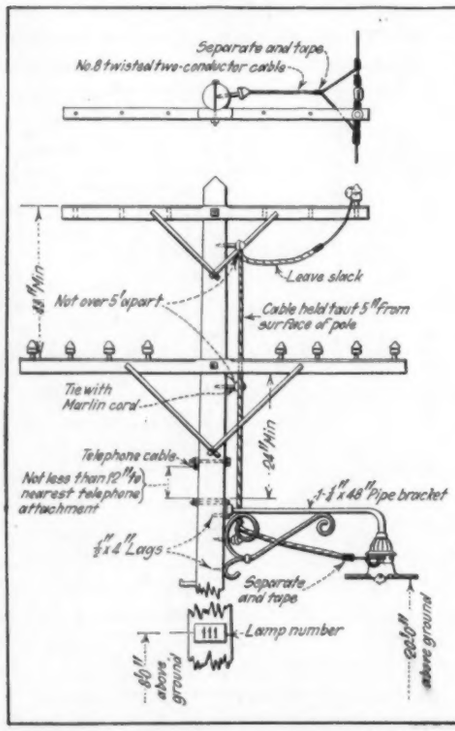


FIG. 65—BRACKET STREET LAMP INSTALLATION ON JOINT POLE

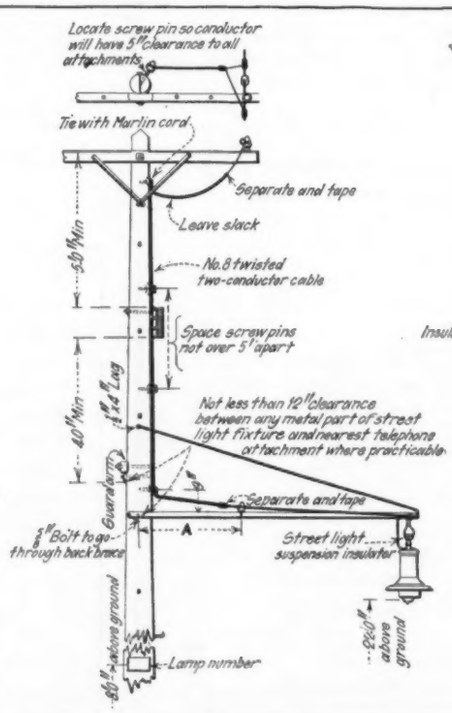

Locate screw pin so conductor will have 5" clearance to all attachments
Tie with Marlin cord
Separate and tape
Leave slack
No.8 twisted two-conductor cable
Space screw pins not over 5' apart
1/2"x4" Lag
Not less than 12" clearance between any metal part of street light fixture and nearest telephone attachment where practicable
Guard arm
Separate and tape
5/8" Bolt to go through back brace
A
Street light suspension insulator
240" above ground
Lamp number

FIG. 66—MAST-ARM STREET LAMP INSTALLATION ON JOINT POLE

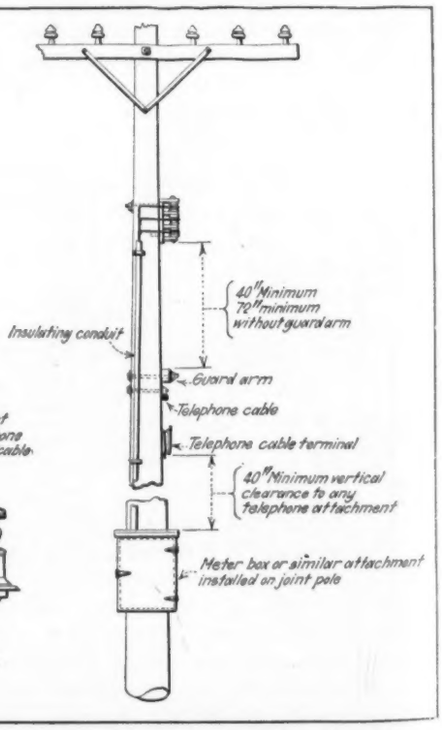

Insulating conduit
40" Minimum
72" minimum without guard arm
Guard arm
Telephone cable
Telephone cable terminal
40" Minimum vertical clearance to any telephone attachment
Meter box or similar attachment installed on joint pole

FIG. 67—APPARATUS BELOW FOREIGN ATTACHMENTS ON JOINT POLE

Keeping Systematic Pole Records

INSTRUCTIONS issued by the Worcester (Mass.) Electric Light Company's distribution department include a recently prepared set of regulations covering the maintenance of pole records. These records are kept in the general engineering department at 66 Faraday Street, Worcester, and are very comprehensive:

The general engineer shall be responsible for the proper upkeep of the pole records. A complete record of all poles in service shall be kept in the general engineering department by the engineering assistant in charge of poles. This record shall consist of a card corresponding to each pole in service, filed according to the street location and pole number.

The chief clerk of the service department shall, upon request, provide necessary clerical assistance for keeping the pole record.

When a work order requiring that poles of any kind be set in new locations is received by the general engineering department, it shall be referred by the engineering assistant in charge of poles to the assistant to the distribution engineer, who shall determine what the pole numbers are to be. The engineering assistant in charge of poles shall then provide a pole record slip (see accompanying illustration) and the necessary numbers, dating nail and stencil for each pole, and then enter the current date and number and location of each pole in the "Poles to Be Set" book.

When a work order to renew a pole is received in the general engineering department, a pole record slip, number, etc., shall be provided as described above.

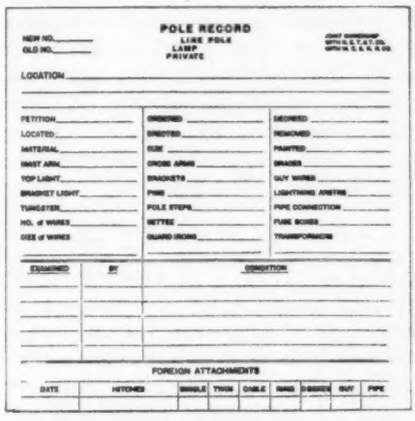
The engineering assistant in charge of poles shall also notify the service record clerk of the location of the proposed poles, and this clerk shall make two copies of a communication to the New England Telephone & Telegraph Company, offering to sell a joint interest to them. One copy shall be sent to this company and the other to the assistant to the distribution engineer, who shall hold it.

The pole record slip prepared by the engineering assistant in charge of poles, together with all necessary metal numbers, dating nails, stencils, work orders and instructions, shall be given to the distribution engineer, who shall check the supplies and pole numbers.

The work order with the pole record slips and supplies shall then be sent to the general line foreman, who shall give them to the line foreman who is to do the work. The line foreman shall enter on the pole record slip all information concerning equipment placed on the pole, and after completing the pole, return the pole record slip, completed with work order, etc., to the general line foreman, who shall return them to the engineering assistant in charge of poles.

The latter shall enter the date the completed work order was returned in the "Poles to Be Set" book opposite the date when the same work order was sent out. He shall also have a pole record card of proper color made out by the information clerk, showing the number and size of the pole, number and date of the work order on which it was set, equipment attached to it, etc. Colored cards shall be used for poles of various types as given in the accompanying table.

In case the engineering assistant in charge of poles receives a pole record slip which indicates that an old pole has been renewed, he shall remove the corresponding card from the file and


POLE RECORD
LINE POLE
LAMP
PRIVATE
NEW NO.
OLD NO.
LOCATION
FOREIGN ATTACHMENTS

POLE RECORD CARD USED BY WORCESTER COMPANY

see to it that all necessary information is entered.

The engineering assistant in charge of poles shall also record on a memorandum slip all new poles, renewals and joint relation changes, from which his weekly report shall be made to the secretary.

The engineering assistant in charge of poles shall enter in a "New Location" book the date, location and number of each pole set in a new location (whether a new pole or an old pole relocated). This book shall be given to the secretary on the first working day of each month, to enable her to make the monthly report to City Hall.

The engineering assistant in charge of poles shall also enter in the "Yearly Pole Record" book each week, from his daily memoranda, a record of every pole set, renewed, abandoned or in which joint interest with other companies has been acquired, together with the date on which change was made.

Poles in which the Worcester Electric Light Company has sold a joint interest to the New England Telephone & Telegraph Company shall be entered in this "Yearly Pole Record" book with green ink, and poles in which the Worcester Electric Light Company has acquired a joint interest shall be entered with blue ink. Totals shall be carried forward with each page and checked so that a record shall at all times be available which is correct to date. This record shall be used at the end of each year for the annual report to the State Public Utilities Commission.

All poles shall be inspected periodically, and in connection with this work the line inspector shall during the winter attach a metal clip to each card corresponding to a pole due for inspection. When the inspection has been made, the line inspector shall turn in a pole record slip for each pole inspected, and the engineering assistant in charge of poles shall see to it that the result of the inspection is transferred from the pole record slip to the corresponding pole record card and that the metal clip is removed from the pole card at the same time.

All iron poles or iron fixtures on wooden poles shall be painted periodically, and such painting shall be reported on the pole record slips. Upon receipt of such slips the engineering assistant in charge of poles shall have the necessary information entered on the corresponding pole record cards.

In case any pole shall be renumbered, it must be reported on a pole record slip, and the engineering assistant in charge of poles shall see to it that the corresponding pole card is corrected, provided, however, that no pole which supports a street lamp shall be renumbered without a special work order.

COLORED CARDS TO BE USED FOR VARIOUS TYPES OF DISTRIBUTION POLES

City street line pole	White
City street joint pole	White and green
Lamp pole	Yellow
Joint lamp pole	Yellow and green
Worcester Electric Light Company pole on private property	Salmon
Joint pole on private property	Salmon and brown
Telephone pole	Green
Privately owned pole	Blue

Beetles Attack Lead Cables and Interrupt Service

BY S. R. WINTERS
Washington, D. C.

INVESTIGATIONS by the Bureau of Entomology of the United States Department of Agriculture have produced substantial evidence in support of the theory that the depredations of beetles upon the lead sheathing of telephone cables can cause a stoppage of service. Similar investigations have proved that electric light and power companies have suffered from attacks by beetles on aërial cables. Southern California appears to be a concentration point for the "lead-cable borers," as they are called, injury by insects being blamed for one-fifth of the aërial cable trouble in this district. Galveston, Fort Worth, Brownsville and Houston, Tex., furnish authentic instances of attacks having been made upon telephone cables. The telephone company at Washington, D. C., has reported damages to fuses in boxes as a result of the activities of boring insects.

A variety of insects have been in-

FIG. 1—HOLES BORED IN LEAD SHEATHING OF AËRIAL CABLES BY BEETLES

cluded by the Bureau of Entomology among those attacking or penetrating metals. The chief offender is known as the "powder-post" beetle, the technical name being *Scobicia declivis Leconte*. The adult of this insect is small in size, the average length being 5.85 mm. and the average width 2.10 mm.

The lead sheathing of telephone cables is the chief point of attack of this beetle. Circular holes about 0.1 in. in diameter are usually bored into the sheathing. The entrance of moisture through these holes causes a short-circuiting of the wires. The experiments of the federal government indicate that this beetle can penetrate any lead alloy used as a cable sheathing. Poisonous baits have no effect on beetles, since evidently they do not bore lead and eat at the same time. Beef tallow applied as grease on the messenger rings of the cable appears to be the most effective agent in thwarting the efforts of the insects, and the bureau therefore suggests the coating of the suspension ring with this substance.

The original observations at Falls Church, Va., near Washington, D. C., involved the shipment of 500 lb. of California oak from the Pacific Coast. This wood, infested with the cable-boring beetles, was deposited in a cage built for the purpose. As the beetles emerged from the wood they were inclosed in glass cylinders with covers of test-sheet lead. The smooth lead in some

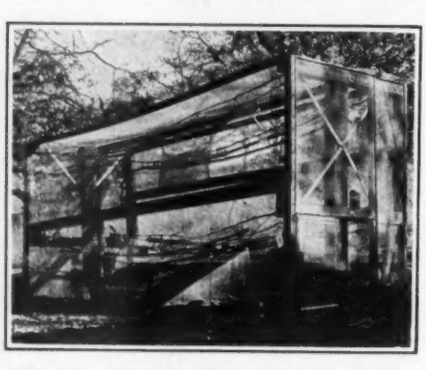


FIG. 2—CABLES INSIDE OF TESTING CAGE SUSPENDED BY VARIOUS TYPES OF RINGS

instances was scratched with a nail to prevent the insects from slipping on its surface. In other containers strips of copper were nailed to the lead, thereby enabling the beetles to secure a footing for their boring activities. Other insects were released in a large cage in which cables made of alloys were suspended on different designs of rings, wire and tape. In this case the cables were not penetrated, the beetles instead boring into the beams of Southern yellow pine supporting the cage. Lead sheathing of varying alloy compositions was then wrapped around the insect-infected portions of the logs. The beetles penetrated a double thickness of No. 3 alloy lead containing 99 per cent lead. They also attacked successfully commercially pure lead.

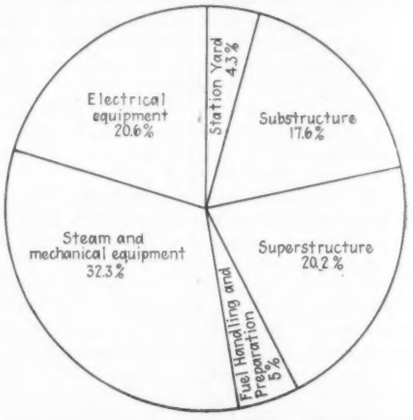
FURTHER EXPERIMENTS

At Los Latos, Cal., other investigations were made to discover a poison or a substance for use as a cable sheath that the insects could not penetrate. Beef tallow, refined paraffin, a mixture of tallow and refined paraffin, arsenate of lead, a solution of sodium silicate, creosote, varnish, tire tape, tarred building paper, commercially pure lead sheathing, copper-coated lead and tin-coated lead were among the materials employed either as repellents or as substances to prevent the penetrating effects of the "lead-cable borer." Nineteen out of twenty-five insects bored through the arsenate of lead without exhibiting any ill effect from the poison. Three and four coats of spar varnish applied to freshly cut portions of oak proved to afford a place for the beetles to lay their eggs. Refined paraffin did not repel the insects when the material was cold and hard; when the weather was warm the paraffin softened and the pests were killed while boring into the wood. Four out of six beetles penetrated black paint and a solution of one-third creosote without hesitation. A mixture of beef tallow and refined paraffin proved to be a repellent as long as the material was in a soft condition.

Several thousand beetles were placed in contact with a miniature telephone system, with cables carrying the ordinary current of electricity. As long as they were confined to large cages they made no attempts to penetrate the cables. When placed in small cages, however, fifteen out of eighteen beetles attacked the cable and made attempts to penetrate it.

Division of Costs in Saxton Plant

THE relative cost of the various portions of the new Saxton plant of the Penn Central Light & Power Company, made available by Alfred Iddles, chief power engineer of Day & Zimmermann, Inc., Philadelphia, are given in the accompanying "dollar chart." At present this plant is operating two 10,000-kw. generators, the ultimate capacity being 100,000 kw. The prorated items are distributed proportionately over the various other sectors.



"DOLLAR CHART" FOR 20,000-KW. STATION

	Per Cent
A—Station Yard ..... Railroad tracks, roadways, electric lights and signs, switching structure.	4.3
B—Substructure ..... Complete below-ground surface, including machine foundations, intake and discharge and cost of land.	17.6
C—Superstructure ..... Complete above-ground surface, including temporary lights.	20.2
D—Fuel Handling and Preparation... Track scale, coal elevating and distributing equipment and stokers.	5.0
E—Steam and Mechanical Equipment Boilers and superheaters Boiler settings Drain system Feed-water system Condenser system Piping Auxiliaries Turbo-generators Ash-handling equipment (Includes generator end of turbo-generator. Does not include driving motors and controls for mechanical equipment).	32.3
F—Electrical Equipment ..... All electrical equipment, all wiring and also all equipment for outdoor switching structure.	20.6
G—Probated Items Enginering and drafting Field office supervision and expenses Insurance Starting up and testing Taxes and interest during construction Engineering fee.	

Central Station Business

Advertising, Selling and Service Methods
Commercial Organization and Management, Customer and Trade Relations, Public and Financial Policies, and Reports of Company Plans and Experiences

Establishing Public Contact that Helps

THE attention of the younger generation can be attracted to the functions of utilities by affording pupils an opportunity to prepare advertising appeals, according to the recent experience of the Public Service Company of Oklahoma.

An "advertising copy contest" was conducted at the Tulsa (Okla.) high school in which a weekly prize and a grand prize were offered for the best advertisement submitted in each of thirteen seven-day periods. The purpose was to ascertain what effect the company's regular advertising had on high-school students. More than four hundred advertisements were submitted, the majority being well written and demonstrating a surprising knowledge of the utility business on the part of the contestants. It is planned to use many of these advertisements as regular copy for the daily newspapers of Tulsa.

The grand prize was a white silk and wool sweater, adorned with the monogram of the Public Service Company of Oklahoma, worked in a red diamond-shape field.

Fair Play for the Public

TELLING the public the absolute truth without fear or favor about inside utility facts is a procedure any company may well be proud of. A recent letter from Donald McDonald, vice-president of the Louisville Gas & Electric Company, displays a fearless, aboveboard attitude in showing why artificial-gas service, if further expanded, will be more expensive. It is especially significant that, although this utility also serves 43,000 electrical customers, no direct reference was made to the use of electrical heating apliances to offset the increasing price of gas. Mr. McDonald's letter follows:

Do Not Depend on Gas

A great many people are planning to have gas mains extended to reach their houses and to buy fixtures for gas heating. Before our citizens make these expenditures it is proper that they should know the exact facts regarding the present and future status of the gas supply.

The supply of natural gas cannot be increased. On the contrary, it is certain to diminish. The supply of artificial gas is now about 14,000,000 cu.ft. per day, and can be increased to any amount. Artificial gas is expensive, the material entering into its manufacture costing more than the present selling price of gas in Louisville. In other words, it is impossible to maintain the gas service of Louisville at anything like the present price by depending on artificial gas.

It is evident from the above facts that either the gas service will fail on the cold days, or that the amount which a householder can burn in a day will have to be restricted, or the price raised to a point that will allow the unlimited manufacture of artificial gas. No one of these alternatives is pleasant to contemplate, but this company wants the citizens of Louisville to know these facts before they invest their money in gas pipes or gas appliances, and especially before they depend upon gas to keep their families comfortable in cold weather.

We earnestly hope that all householders will consider carefully before investing in gas appliances and will arrange their affairs in such a way that they can keep their families comfortable even though the amount of gas available is not sufficient to keep up the pressure.

Arousing Executive Interest in the Electric Range

A SIDELIGHT upon the development of the electric range load may be seen in an incident which occurred at the annual business men's show in Asbury Park, N. J., this spring. One of the most attractive booths at the exhibit was that of the Eastern New Jersey Power Corporation, which featured a special electric cooking demonstration by Miss Walker of the Edison Electric Appliance Company. During one of the sessions of the exhibit a visitor approached the booth and asked to be shown one of the electric ranges. It was demonstrated to him and his numerous questions were answered in detail. After he had received all of the information desired he presented his card, and it was found that he was the president of the holding company which controls the local Asbury Park utility.

CENTRAL-STATION COMPANY'S ELECTRICAL APPLIANCE EXHIBIT WHICH FEATURED ELECTRIC RANGES

The sequel to this incident, however, is most interesting. Among the questions that had been asked was how much it would cost to operate an electric range. He had been informed that the rate was 12 cents per kilowatt-hour for the first 10

kw.-hr. and 5 cents for all over that amount. Upon figuring up his approximate monthly bill he thought the total was excessive and took steps at once to have put in effect a new rate schedule of 4 cents per kilowatt-hour with a $1 minimum charge for electric range service. While this may not be a scientific method of arriving at the proper rate for this kind of service, it illustrates the keen interest that executives have in commercial problems when they are forcefully brought to their attention. Had not this official received an actual working demonstration of the electric range in operation and figured out for himself the cost of cooking electrically under the existing rate, it is doubtful whether any amount of correspondence or reports recommending a reduction in rates for the purpose of promoting the electric range business would have aroused his interest and brought immediate action.

Electric Range Maintenance Costs

Service and Installation Cost Data Compiled by a Company Which Operates a Special Department for this Work

BY A. H. KRUEL
Assistant Superintendent Meters and Service
Portland (Ore.) Electric Power Company

IT IS the policy of the Portland Electric Power Company to service electric ranges free of charge to its customers, and as a result of this practice the company has established a cost-keeping system showing the labor, material and cartage expense of maintaining each make of range. From this record it can be ascertained which make of range is the most expensive as well as which is the cheapest to maintain, both as regards labor and material. The record also shows the average cost per complaint and the cost of installing the range.

In order to discover and correct the weak points of the different makes of ranges, a record of defective parts was started on July 1, 1923, and this information was compiled daily, as the service repair slips were turned in showing the parts repaired or replaced. This record shows all renewals and repairs on parts such as coils, hot plates, both open and closed, switches, contact plugs, oven linings, thermometers, clocks, automatic switches and wiring trouble for all makes of ranges. This information has been very useful in disclosing at once to manufacturers the source of defects which are substantiated by concrete facts and has been instrumental in several instances in leading the manufacturer to improve parts that were giving trouble.

Table I shows the complete maintenance costs to the company, excluding the parts replaced free by the manufacturers which have become defective within the first year's guarantee. Attention is called to the cost of material, which represents about 54 per cent of the total maintenance cost and which increases with the age of the range.

Table II shows that the average number of complaints received from each range per year is two and one-half and that the cost per call is $2.75. This is an expense to the central station which the customer as a rule does not appreciate.

TABLE II—RANGE COMPLAINT COSTS, 1923

Total complaints	6,059
Average number ranges in service	2,348
Complaints per range	2.5
Labor cost, 1923	$5,600.12
Material cost, 1923	8,414.01
Cartage cost, 1923	1,545.21
Total cost, 1923	$15,559.34
Labor cost per complaint	$0.92
Material cost per complaint	1.39
Cartage cost per complaint	.26
Total cost per complaint	$2.57

TABLE III—RANGE INSTALLATION COSTS, DURING 1923
(Does not include wiring)

Total number ranges installed	1,361
Labor cost	$10,257.02
Material cost	4,728.41
Cartage cost	1,481.24
Total cost, 1923	$16,466.67
Labor cost per range	$7.53
Material cost per range	3.47
Cartage cost per range	1.09
Total cost per range	$12.09

Table III shows the cost of installing a range and represents the expense of uncrating, burning off, delivering and connecting the range in the kitchen to the outlet box. It does not include inside wiring or connecting outside service wires.

Table IV is a summary for the past five years of the unit costs of maintaining electric ranges by this central station.

Table V is a classification of range complaints and indicates immediately that the greatest source of trouble is due to the heating coils, with switches and thermometers following closely. There seems to be a large demand for automatically controlled ovens and likewise much room for improving such devices now in use.

TABLE IV—RANGE SERVICE COSTS FOR FIVE-YEAR PERIOD

Year	Ranges in Service Dec. 31	Average Ranges in Service	Number of Complaints	Complaints per Range	Labor Cost	Material Cost	Cartage Cost	Cost per Complaint	Total Cost per Range
1919	620	456	1,153	2.5	$3.96	$1.56	Included	$2.18	$5.52
1920	782	701	1,506	2.1	4.54	3.34	in	3.67	7.88
1921	1,082	846	2,009	2.3	5.31	2.53	material	3.30	7.84
1922	1,615	1,348	3,141	2.3	3.30	4.08		3.17	7.38
1923	3,081	2,348	6,059	2.5	2.38	3.59	$0.66	2.57	6.63

TABLE I—RANGE SERVICE COSTS FOR 1923

Type	Ranges in Service Jan. 1, 1923	Ranges in Service Jan. 1, 1924	Average Ranges in Service 1923	Labor Cost 1923	Material Cost 1923	Cartage Cost 1923	Total Cost 1923	Labor Cost per Range	Material Cost per Range	Cartage Cost per Range	Total Cost per Range
B	225	478	352	$880.33	$1,431.90	$241.74	$2,553.97	$2.50	$4.06	$0.69	$7.25
C	196	745	471	1,652.69	2,050.57	463.27	4,166.53	3.53	4.36	.98	8.85
D	417	915	666	1,724.70	2,410.84	505.40	4,640.94	2.59	3.62	.75	6.96
E	64	139	101	160.42	398.91	29.15	588.48	1.59	3.95	.28	5.82
F	33	31	32	28.39	23.04	3.03	54.46	.89	.72	.09	1.70
G	52	62	57	123.22	305.98	40.58	469.78	2.16	5.37	.71	8.24
H	7	18	12	22.22	5.58	7.65	35.45	1.85	.46	.64	2.95
I	458	498	478	812.89	1,519.68	210.21	2,542.78	1.70	3.18	.44	5.32
J	88	102	95	110.46	246.04	29.56	386.06	1.16	2.57	.33	4.06
K	75	93	84	84.80	21.47	14.62	120.89	1.01	.25	.18	1.44
Total	1,615	3,081	2,348	$5,600.12	$8,414.01	$1,545.21	$15,559.34	$2.38	$3.59	$0.66	$6.63

TABLE V—CLASSIFICATION OF RANGE COMPLAINTS

July to January Inclusive, 1923

	Total Complaints
Open coils in hot plates:	
500 watts	107
667 watts	214
750 watts	9
440 watts	40
1,000 watts	106
1,500 watts	24
Open hot plates, complete:	
440 watts	31
1,000 watts	199
1,500 watts	59
2,000 watts	...
Closed hot plates:	
1,000 watts	109
1,200 watts	2
1,500 watts	88
2,000 watts	...
Open elements:	
500-watt coils	...
750-watt coils	6
Open-wire	78
Sheath-wire	16
Switches:	
Repaired	127
Replaced	211
Oven contact plugs:	
Repaired	60
Replaced	20
Top contact plugs:	
Repaired	84
Replaced	60
Ovens relined:	
Relined	...
Repainted	3
Repaired	...
Thermometers:	
Adjusted	77
Replaced	75
Contacts	26
Clocks:	
Repaired	...
Replaced	57
Auto switches:	
Repaired	66
Replaced	24
Wiring:	
Shorts	19
Grounds	45
Opens	69
Loose connections	36
Reflectors	44
Oven doors repaired	65

The company's range organization now consists of a foreman, three service men with automobiles fully equipped with a large stock of parts, two installers with helpers operating two trucks for delivering ranges, and two men in the shop who uncrate, burn off and repair ranges to be put in service. During range campaigns, when as many as twelve ranges are installed in one day, a third machine with a crew is added in order to meet the demand for immediate service required during these campaigns.

From the experience of the Portland Electric Power Company it is felt that the electric range is fast passing from a luxury to a necessity, and the large amount of new residence construction under way would seem to indicate that a larger number of electric ranges will be installed during the coming year than in any previous year. During 1923 the Portland Electric Power Company added 1,466 ranges to its lines, bringing the total number installed up to 3,081, having a total connected load of about 21,000 kw. and earning an annual gross revenue of approximately $195,000.

Ferreting Out Causes of High-Bill Complaints

FOR some time M. S. Sloan, president of the Brooklyn Edison Company, has been sending out with monthly bills to customers a message regarding some interesting phase of the company's service. The messages are intended to illustrate, by a definite example, some point or circumstance that might be encountered by any customer in its dealings with the company. Recently he told the story of a druggist who complained that his bills had suddenly become nearly twice what they used to be, although there had been no change whatever in the routine of the store. There had been almost no change in the bills for nearly ten years, and the druggist was at a loss to understand the sharp increase.

"We tested the meter and found it correct," says Mr. Sloan. "We took daily readings and found that the bill was correct. This was a puzzling situation. No change in the number of lights or in the time that they burned, yet a big increase in the bill. Our tests showed that the bill was correct. We couldn't explain it; the druggist couldn't explain it, but he insisted that it was wrong.

"We put an all-night watch on the drugstore. The druggist had recently hired a new clerk. We found that at night, after the druggist had locked up and gone home, the clerk would return to the store and play poker in the back room with a few friends. It was the poker game that boosted the bill. The druggist boosted the poker game—right out of the store." The moral of this story for business men, as Mr. Sloan says, is: "Watch for the poker game."

Dealers to Act as Power Company Agents

FOURTEEN electrical dealers of Denver have accepted the plan offered by the Public Service Company of Colorado to allow the dealers to collect the monthly service bills of its customers. This practice was proposed by the central station to meet the objection frequently raised as to the advantage the company has in selling appliances to its customers through the contact made when they come to pay their service bills. The inauguration of the plan should enable the dealers to share in the appliance business of the central-station company provided that they are aggressive enough to take advantage of the contact thus made.

Women Employees of Georgia Railway & Power Company Inspect Hydro Plants

ON JUNE 7 and 8 the officers of the Georgia Railway & Power Company were hosts to the two hundred women employees of the company on a trip to the hydro-electric developments of the company in the northern part of the state. This was undertaken as an activity of the Women's Public Information Committee.

Four special railway coaches were required to take the party to Tallulah Falls, where a hotel was leased for the two days. Inspection trips were made to the Mathis, Terrora, Tallulah, Tugalo and Yonah developments, a fleet of automobiles being used to carry the guests over the properties. Special entertainment features of the trip were a fish fry at the Mathis dam, a leap-year dinner-dance at Tallulah and a picnic luncheon at Yonah. After the inspection of the recently started Yonah development, the company train carried the party on flat cars 12 miles down the Tugalo valley to the main line of the Southern Railway. The accompanying photograph was made at the fish fry at Mathis dam.

Digest of Electrical Literature

Including Brief Abstracts of and References to
Important Articles Appearing in the Scientific and Engineering Press
from All Parts of the World

Photostat copies or English translations of complete articles will be furnished at cost upon request

Generation, Control, Switching and Protection

Construction, Selection and Operation of Automatic Oil Circuit Breakers.—O. L'EPLATTENIER.—A comprehensive treatment of the entire subject is given with particular consideration of the latest accomplishments. Electrostatic and thermodynamic phenomena are discussed in detail in the first part of the article. The manufacturing influence upon the phenomena of rupture is then explained at length by considering the material, form and length of contacts, the number of ruptures, their velocity and their measurements. The author concludes by specifying the requirements an automatic oil circuit breaker must meet. Charts reporting practical and experimental data and photographs showing various details of construction accompany the paper.—*Elettrotecnica*, April 5, 1924.

Explosion of an Oil Switch.—H. HEINICKE.—An unusual fault on an oil switch which occurred recently in a German power house of 80,000 kva. capacity is described in this short paper. A three-phase oil switch, designed for 6,000 volts and 2,000 amp., serving as a connecting switch between two generator buses, exploded, tearing open the bottom and one of the side seams of the large round steel tank. This was followed by an ignition of the generated oil gases which resulted in considerable damage to the building. An investigation disclosed that the magnet for remote closing of the switch had, for some reason, reached its end position before the main contacts of the switch were closed. Only the auxiliary contacts closed, and they were connected to the main contacts over a protective resistance of 28 ohms. The two bus sections were therefore tied together over this oil-immersed resistance, which is designed for intermittent use only. Within less than one minute this resistance burned out and an arc established itself under the oil, generating a large amount of oil gases which were unable to escape quickly enough through the exhaust pipe, this pipe being only ¾ in. in diameter. The result was the demolition of the switch tank. To prevent a repetition of such an accident much wider exhaust pipes will be installed and an indicating device will be added to these switches to show the actual position of the main contacts.—*Elektrotechnische Zeitschrift*, May 1, 1924.

Oscillations and Resonance in Systems of Parallel-Connected Synchronous Machines.—H. V. PUTNAM.—A method has been developed for calculating the resonance frequency of two synchronous machines electrically in parallel. It is shown that in a system of n machines in parallel there are $n-1$ resonance frequencies. A general method of calculating these is given. Systems of three and four machines are treated as special examples of the general case. The theory is also given for calculating the actual power pulsations which occur in systems of two and three synchronous machines connected to reciprocating apparatus. With some approximation the theory is extended to four machines and a general method for n machines is suggested. Simple methods of calculating the correct sizes of flywheels necessary for the successful parallel operation of engine-driven generators are given. These are calculated directly from a knowledge of the resonance frequencies involved. Specific problems have been treated and illustrative examples presented which make clear not only the nature and causes of hunting but also the methods of overcoming it.—*Journal of the Franklin Institute*, May, 1924.

Hydro-Electric Development and Steam Equipment

Water-Power Resources in Canada.—The hydro-electric power installations in Canada now total 3,227,414 hp., an increase of 250,000 hp. during the past year. How this is distributed throughout Canada is shown in the accompanying table. The figures for undeveloped water power are based upon rapids, falls and power sites of which the actual head is definitely established. At present more than 900,000 hp. is being developed. The total power now averages 353 hp. per 1,000 population, representing an investment of $687,000,000. Detailed tabulations are given in the article of the developed water power in Canada, the water power utilized in the central-station industry and the water power utilized in the pulp and paper industry.—*Canadian Engineer*, May 20, 1924.

AVAILABLE AND DEVELOPED WATER POWER IN CANADA

Province	Available Twenty-four Hour Power at 80 per Cent Efficiency At Ordinary Minimum Flow, Hp.	At Ordinary Six Months' Flow, Hp.	Present Turbine Installation
Brit. Columbia..	1,931,142	5,103,460	355,517
Alberta.....	475,281	1,137,505	33,067
Saskatchewan....	513,481	1,087,756	.....
Manitoba.....	3,270,491	5,769,444	162,025
Ontario.....	4,950,300	6,808,190	1,445,480
Quebec.....	6,915,244	11,640,052	1,116,398
New Brunswick.	50,406	120,807	44,539
Nova Scotia....	20,751	128,264	54,950
Prince Edward Island.....	3,000	5,270	2,239
Yukon and Northwest Territories.....	125,220	275,250	13,199
Total.....	18,255,316	32,075,998	3,227,414

Heat Losses Through Insulating Materials.—R. H. HEILMAN.—With the higher temperatures due to the use of superheated steam in power plants, the problem of providing suitable pipe and boiler insulation is becoming a difficult one. The present paper is, therefore, timely in that it includes the results of numerous and exhaustive tests on commercial pipe coverings and insulating cements, which are presented in curves, tables and formulas that can be readily used by the engineer. Interesting experimental methods are described, and the exact character of thermal conductivity and its relation to temperature gradients and differences is discussed from a physical and mathematical standpoint.—*Paper presented before the A. S. M. E., Cleveland*, May 26-29, 1924.

Transmission, Substations and Distribution

Design of Transmission Lines.—I. W. T. TAYLOR.—The author starts with the size of the conductor and shows that it must be determined (not assumed) before the length of span between the line supports can be settled and that it is best to determine the size of the conductor from a knowledge of the percentage of power loss that the particular line can bear. A chart is given by the aid of which this information can be obtained.—*Electrical Review (England)*, May 16, 1924.

Effect of Power Lines Upon Telephone Lines.—P. JAGER.—Comparing the electrical energy transmitted over a telephone line, amounting to 1 milliwatt or less, with that of many thousand kilowatts through a high-voltage power line, it becomes obvious that even a very loose coupling between the two is liable to cause severe trouble to the former. This condition is further aggravated by the sensitiveness of the human body. A crackling noise may be caused in a telephone receiver by as little as 0.01 watt-second. In this very elaborate paper the author investigates the various kinds of coupling, such as capacity, induction and galvanic coupling for single-phase (railway), three-phase and rectifier systems. Interferences between signal and power lines are studied for perfect condition of the latter and for ground faults. A large number of oscillograms are shown, giving examples of disturbances actually observed on telephone and telegraph lines. The value of protective devices for connection to signal lines and those for power lines is discussed and analyzed.—*Elektrotechnische Zeitschrift*, May 1, 1924.

Units, Measurements and Instruments

Peak Voltage Measurement by Means of a Neon Glow Lamp.—L. E. RYALL.—One of the characteristics of the neon glow discharge lamp is that it requires a certain "striking voltage" before a current passes and a glow appears. It is this voltage that is utilized in the determination of "peak voltages" and "crest factors." The general theory of the apparatus, how it is constructed and several experiments and tests are given.—*World Power (England)*, May, 1924.

Measurements of Temperature.—P. NICHOLLS.—The author deals with the temperature range in refrigeration insulation and with the difficulties encountered and the precautions neces-

sary. Locations at which temperatures are taken, as well as the accuracy procurable, depend upon the object and scope of the work, which is classed under the divisions of air temperatures, surface temperatures, temperatures at different points in a solid, and liquid temperatures. The thermometer devices available for measuring such temperatures are mercury in glass thermometers, resistance thermometers and thermocouples. Among the subjects covered are literature on thermometry, fundamental principles of thermometry, methods and instruments, calibration of instruments, accuracy of temperature measurements and temperature measurements in heat transmission investigations. — *Paper presented before the American Society of Refrigeration Engineers, Cleveland,* May 27-29, 1924.

Recording of Vibratory and Torsional Motions. — R. ELSASSER. — In mechanical and electrical engineering it is frequently desirable to measure small torques or vibrations occurring within so short a time or with such high frequency that no mechanical recording device could follow them. The author has developed and describes in this paper a recording apparatus for such problems, using as the recorder itself an oscillograph the loop of which has an exceedingly small inertia and can be made for a frequency of up to 12,000 cycles per second. The linear or circular mechanical motion which is to be investigated is translated into variations of electric current by means of a Wheatstone bridge connection of two stretched-out bare-resistance wires and a sliding contact diagonal. With the latter the loop of the oscillograph is connected. For straight motions the two bridge wires are spanned out parallel and close together; for torsional tests they are arranged on the circumference of a wooden disk. By proper choice of the size of these wires and the current through them a considerable deflection on the oscillograph can be obtained for very minute motions. A number of oscillograms are reproduced to illustrate the reliable and accurate functioning of this new apparatus.—*Zeitschrift des Vereines Deutscher Ingenieure,* May 17, 1924.

Motors and Control

Calculation of Wedges and Dovetails.—F. LASZLO.—Pole pieces on most generators and synchronous motors are secured to the revolving shaft by means of dovetail construction. Windings in armature slots are frequently retained by wedges. The author shows in this mathematical paper that no exact and fully reliable method is known for calculating the forces in these machine parts. To establish the exact magnitude of these forces he describes a testing machine which gives, when used with delicate optical measuring devices, the location and the size of the forces sought. — *Elektrotechnische Zeitschrift,* May 15, 1924.

Improvement of Power Factor.—K. BANDISCH.—Considering the improvement of low power factor on existing networks, the author describes various practical methods, from large synchronous condensers to the smallest power motors of special design, used today to compensate lagging current. The efforts to maintain unity power factor even for very small motors have led within the last few years to the design of a great number of special three-phase motors operating with characteristics of a synchronous machine. Several of these new types are explained and analyzed. The fact that all of them have a commutator in addition to collector rings is a general disadvantage of these motors, which are intended to replace the simple and rugged squirrel-cage armature induction type. Some of these "compensated" motors are being manufactured for as little as 1½ kw. output.—*Elektrotechnik und Maschinenbau,* May 11, 1924.

Heat Applications and Material Handling

Electric Smelting of Iron Ore.—H. BATT.—A historical review of the development of electric smelting of iron ore in Norway, with special reference to the results recently obtained in experiments performed by the Norwegian government. — *Teknisk Ukeblad (Norway),* Feb. 15, 1924.

Fluxes and Slags in Welding.—W. SRARAGEN.—The author deals primarily with the use of fluxes and slags in fusion welding. The material contained in the article is principally a digest of the opinion of experts in America on this subject. The action of these fluxes for electric arc, gas and resistance welding is also treated.—*Journal of the American Welding Society,* April, 1924.

Relation Between Current and Temperature of Resistance Wires. — F. STABLEIN.—It has been desirable for many practical electric heating problems to establish a formula with which the current required to bring a resistance wire to a certain temperature can be calculated. Existing formulas hold true only for certain resistance alloys, are usually based on round wires only and disregard heat radiation, convection and conduction through the air. On an experimental basis the author arrived at a new formula which has the advantage of being generally applicable to any kind of resistance material of any cross-section. In eight examples the close approximation of actually measured values to those calculated with the new formula are shown. It is also possible to compute the temperature to which a certain conductor will be heated by a given current. — *Elektrotechnische Zeitschrift,* May 15, 1924.

Electrophysics, Electrochemistry and Batteries

Electrolytic Production of Hydrogen and Oxygen.—M. HANSEN.—For certain chemical reactions large amounts of very pure hydrogen are required. For this the electrolytic production of this gas is the cheapest, as no further refining is necessary. Few types of hydrogen-generating cells have been a practical success. Recently a Norwegian concern has developed a new electrolytic gas generator which shows marked improvements over existing designs. A plant with 400 of these cells has been in continuous operation since 1919 without having needed repairs of any kind. The cells operate with sodium hydroxide as electrolyte and a current of 3,000 amp. A yearly average efficiency of 4.8 kw.-hr. per cubic meter of hydrogen has been maintained. The purity of the generated gases is very high, viz., 100 per cent for the hydrogen and 99.75 per cent for the oxygen. To attain this high degree of purity requires, however, the use of distilled water in the cells. A very convenient and inexpensive way to obtain distilled water is to install an electric electrode boiler, the steam of which is compressed in a turbopump and condensed. A particular claim is made for the unusually small floor space of these new cells, which require about 1 sq.m. for an hourly hydrogen output of 5 cu.m. Older types of cells require from 1 sq.m. to 7 sq.m. floor space for 1 cu.m. of hydrogen per hour.—*Elektrotechnische Zeitschrift,* May 8, 1924.

Metal Cleansing with Alkaline Cleaning Solutions.—E. M. BAKER and R. SCHNEIDEWIND.—The efficiency of alkaline cleaning solutions may be judged from measurements of the relative interfacial tensions of water and of these solutions with a standard mineral oil. Measurements have been made of the interfacial tensions for solutions of many substances ordinarily found in commercial cleaners. Typical analysis are given of cleaners used for various purposes, and factors entering into the mixing of cleaners are discussed.—*Paper presented before American Electrochemical Society, Philadelphia,* April 24-26, 1924.

Telegraphy, Telephony, Radio and Signals

New Type of Loud Speaker.—M. BONNEAU.—It has been found very difficult to design a telephonic loud speaker so as to reproduce faithfully and without distortion both speech and music. This was largely due to the use of steel membranes in the way customary with ordinary telephone receivers. A French firm has developed a loud speaker along entirely new lines, and it is claimed that this instrument has a clearness of reproduction heretofore unknown. Instead of reproducing the sounds by a more or less pronounced vibration of a steel membrane before an electrically controlled permanent magnet, the new type of loud speaker has a very strong, closed electromagnetic direct-current field with a fine conically shaped air gap, within which is placed a vibrating cone. The latter is made of very fine silk and carries on its surface a close winding of fine aluminum wire, through which the telephonic current passes. The alternating-current field set up in this cone, which comes within the direct-current field of the magnet, causes the cone to vibrate in perfect accordance with the frequency of the telephone current. The weight of the cone is only 0.8 gram, though it has the considerable surface of 30 sq.cm. Several types of these loud speakers have been developed to suit different conditions.—*Bulletin de la Société Française des Electriciens,* February, 1924.

News of the Industry

Chronicle of Important Events and General Activities, Announcements and Reports of Association Meetings, Court Decisions and Commission Rulings and News of Electrical Men

Chicago Welcomes Institute

Abundant Hospitality, Excellent Program and Good Attendance Aid Success of Meeting

THE Chicago convention of the American Institute of Electrical Engineers, held at Edgewater Beach within the city limits, assembled under auspicious circumstances this week, there being a registration of six hundred on Tuesday night. The hotel arrangements proved especially fine, and inspection trips and social events added to the success of the meeting. Owing to the illness of President Harris J. Ryan, Vice-president R. F. Schuchardt presided at the meetings.

On Monday section delegates, with Chairman A. W. Berresford presiding, discussed and approved the policy of district or regional meetings and considered other matters of interest to the sections. On Tuesday the technical committee reports were presented, following addresses by Vice-president Schuchardt, President-elect Farley Osgood and a representative of the city. The reports created great interest and excited some discussion on installation standardization and general technical committee activities. An informal dance and a musical entertainment on Tuesday night followed the formal reception.

At an educational dinner on Tuesday evening, presided over by W. E. Wickenden, director for the S. P. E. E. committee investigating technical education, college professors and engineers accented the necessity for generally increasing their personal and professional points of contact and agreed upon the need for maintaining the initiative and individuality now existing in educational institutions rather than attempting rigid standardization of courses.

A specially pleasant feature on Tuesday was the reception and lunch given the Institute delegates by the Electric Club of Chicago. Addresses, music and entertainment served to put before the visitors a good picture of Chicago's hospitality. Golf, tennis and bathing, together with card parties and teas, were pleasurable events of the week.

The technical papers and discussions will be abstracted in next week's ELECTRICAL WORLD.

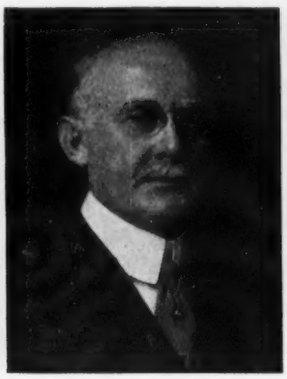
Combating the Shortage of Power in California

At a second hearing called by the California Railroad Commission in Los Angeles on June 19 power company representatives and members of the Los Angeles Chamber of Commerce and the Los Angeles Bureau of Power and Light further considered the question of curtailment to meet the power shortage. H. G. Butler, who acted as power administrator during 1920, was selected as power supervisor. Until the arrival of Mr. Butler from the East one of the commission's engineers will act in this capacity. All power companies in the state are co-operating to the fullest extent, and the Bureau of Power and Light of Los Angeles is taking every possible step to assist the Southern California Edison Company, from which it purchases a large part of its energy. Curtailment orders are to become effective immediately, and the company is issuing a letter to 235,000 consumers explaining them.

Philadelphia Electric Changes Officers

Joseph B. McCall Resigns Presidency and Becomes Chairman of Board, Walter H. Johnson the New President, H. T. Liversidge Fills Vacancy in Vice-Presidencies

JOSEPH B. McCALL



WALTER H. JOHNSON

HORACE P. LIVERSIDGE

AT THE semi-monthly meeting of the board of directors of the Philadelphia Electric Company this week Joseph B. McCall resigned as president and was elected chairman of the board of directors. The change was made at the request of Mr. McCall, who has been in ill health for some time and who desired to be relieved of direct responsibility for the details of operation. Walter H. Johnson, senior vice-president, was promoted to the position of president. The three other vice-presidents were advanced, Arthur B. Huey becoming senior vice-president, and Charles J. Russell and W. C. L. Eglin following in their present order.

The vacancy on the executive staff of vice-presidents was filled by the election of Horace P. Liversidge, who has been assistant chief engineer.

All of these officers have been associated with the company almost or quite since its inception. Mr. McCall was president of the company since its organization in 1899, and Mr. Johnson has been his chief assistant during all that period. Both men have been prominently connected with the central-station industry for a period even longer than the quarter century thus spanned, and their names have become even more familiar to electrical men in all parts of the country from the fact that each has been the president of the National Electric Light Association. Mr. McCall held that office in 1913-14, and Mr. Johnson's term (1923-24) expires this month.

American Canal Around the Niagara Falls a Possibility

Dwight B. La Du, State Engineer and Surveyor of New York, is preparing estimates to show the cost of an American canal to connect Lake Erie with Lake Ontario. Such a canal would leave Lake Erie at Buffalo and follow a semi-circular route to the Niagara River below the falls at Lewiston. It would not only afford navigation facilities but would permit of extensive state-owned power development. The diversion of water from the Niagara River would be subject to the limitations now defined by international treaty. The plan would conflict with the proposal of the American Superpower Corporation, organized some two years ago, to undertake a similar project, though without the feature of a navigable canal.

Controlling Niagara Falls

Company Builds Model to Show Effect on Beauty from Variations of Draft and from Weirs

A LARGE-SIZE model of Niagara Falls which faithfully reproduces not only the topography but the flow of water down the Niagara River and over the cataract has been built in the grounds of the Niagara Falls (N. Y.) Power Company.

The model is about 100 ft. x 125 ft. in plan and on a horizontal scale of one to one hundred. The vertical scale is somewhat less than that in order that the perspective of a nearby spectator may be maintained. The model is a remarkably exact copy of the natural falls, especially in the appearance of the flow of the water over the cataract and in the upstream rapids.

The object of this model is to demonstrate, first, the effect on the scenic quality of the falls by varying the draft of water above the falls for power purposes in accordance with various plans proposed and, second, the possibilities of remedial measures above the falls in the way of weirs or similar obstructions, the intention of which is to spread the flow of water over the brink in such manner as to increase the scenic qualities under lowered flow.

The model includes a reservoir simulating the Niagara River above the falls. In this section there are reproduced in exact scale the various power houses on each side of the river. These miniature power houses have outlets with gages to measure the flow through them so that the draft at each can be made equal to that which it now takes or which may be proposed under any scheme. A demonstration of the model consists in showing first the full flow of the river as it is at present and then the flow of the river under increased drafts through the various power houses. The effect of these increased drafts shows perceptibly in the amount of flow over the falls and more especially in the distribution of that flow. In the model there are, besides, miniature weirs and artificial islands placed in various positions above the brink of the Canadian Falls and also at the upper end of Goat Island, and the diminished flow is by this means distributed so as to be uniform across the entire brink.

The Niagara Falls Power Company has built this model partly for demonstration and partly for experimental purposes. It is not offering at the present time any solution of the problem of how best to distribute a diminished flow to increase scenic effect, but it offers the use of the model to any one who has an idea concerning a method of improvement so that the method may be tested out experimentally. The model was built under the direction of John L. Harper, vice-president and chief engineer of the power company, after the hydraulic calculations of Norman R. Gibson of the company.

Educate Employees, but Inform Public

This Distinction Meets with the Approval of Pacific Coast N. E. L. A. Delegates—Women's Session Is Held—Wooden Poles Hold Their Own—Other Topics

WITH the unanimous approval of the executive committee of the Pacific Coast Electrical Association, a resolution was passed at the annual convention of the association at Coronado, Cal., June 17 to June 20, asking the National Electric Light Association to hold its annual convention for 1925 at San Francisco. The sessions of the first two days of the convention, as reported in last week's issue of the ELECTRICAL WORLD, showed that the past year had been an active one with many definite achievements. The discussion in the commercial meetings indicated a need for a better merchandising policy for central stations and dealers and for better co-ordination between all merchandising agencies in order that the power companies may obtain the saturation of appliance business they desire. The necessity for some system of properly training salespeople was brought out, and next year's Appliance Bureau will attempt to work out the solution of this problem.

One of the high spots of the convention was a public relations meeting at which R. E. Smith, Southern California Edison Company, presented a paper on "Common Sense in Public Relations." In his opinion the real basis of public relations is getting along with the public as individuals rather than as a mass, and he maintained that when individual good will has been obtained group antipathy to public utilities will disappear. He voiced objection to the term "Educate the public" and suggested instead educating the employees and informing the public.

One of the important activities of the Public Relations Section during the past year was the organization of the "Smiles Club" to promote courtesy in the electrical industry. A report on this movement indicated that more than thirty thousand members have been enrolled in California.

For the first time in the history of the association the women who attended the convention had a definite place on the program. A meeting devoted to them was held on the second day, when more than fifty women attended and displayed a keen interest in the affairs of the association and in the workings of the electrical industry.

The publicity committee also had a definite part in the program of the convention for the first time for the discussion of the problems of the news and advertising departments of the member companies. This committee considers its work so important that a resolution was passed offering the executive committee of the association a new plan of organization following out the bureau plan adopted by the other sections.

In reporting on the work of the Accounting Section Chairman A. B. Carpenter, San Joaquin Light & Power Corporation, asked the early consideration of the member companies for the matter of allocation of earnings and expenses to projects operating under federal license. He also recommended that next year's committee consider commercial department expense.

One of the important subjects investigated by the overhead systems committee was the use of steel poles as a substitute for cedar poles. It was felt that the principal use for steel poles would be in transmission and trunk-feeder lines rather than in distribution service. With the present cost of

VIEW OF NIAGARA FALLS AND OF MODEL TO DEMONSTRATE FLOW CONTROL

On left: Niagara Falls from a point in the air above the Canadian shore. On right: The 100-ft. x 125-ft. model of Niagara Falls from a point of similar advantage.

wooden poles, steel is uneconomical for short spans, and, furthermore, the important problem of being able to work on live circuits on steel poles has yet to be solved. Discussion brought out that span lengths of more than 400 ft. must be used with steel-pole construction if real economy is to result.

R. E. Cunningham, Southern California Edison Company, said that one of the most serious problems facing the utilities in southern California is the fortifying of wooden poles against the attacks of the termite, a wood-boring insect. In an effort to solve this problem his company will erect a thousand Douglas fir poles, the entire pole being subjected to the empty-cell-pressure creosoting process.

In discussing a paper on automatic reclosing circuit breakers John Koontz, Great Western Power Company, said that more consideration must be given to the rating of oil circuit breakers used in this service if trouble is to be avoided. Present practice in regard to rating will give a circuit breaker of entirely too low a rupturing capacity when applied to automatic reclosing service.

PUBLIC SERVICE CONFERENCE

The Western development conference which has been a feature of the closing session of the Pacific Coast Electrical Association convention for several years was this year replaced with a public service conference. Speakers representing all classes of public utilities in California emphasized the necessity of closer co-operation between utilities, especially in considering their common problems and combating their common enemies.

At a general meeting M. H. Aylesworth, managing director of the N. E. L. A., spoke on the case against municipal ownership.

More than three hundred attended the banquet which concluded the convention on Friday night and listened to an address by Chester H. Rowell, former member of the California Railroad Commission.

Professors to Make Researches at Schenectady

A conference of engineering professors is to be held at the Schenectady works of the General Electric Company from July 7 to August 9. It is the company's plan to have each professor spend the greater part of his time in the department in which the work most closely coincides with his own special subjects. Twice a week visits of inspection will be made throughout the plant, followed by round-table conferences with General Electric engineers. A one-day trip to the Pittsfield plant is also planned for the purpose of studying transformer manufacture.

Among the educational institutions to have representatives at the conference will be the Virginia Polytechnic Institute, Texas Agricultural and Mechanical, Pennsylvania State, University of Idaho, Lehigh, University of Kansas, Rhode Island State College, Michigan Agricultural College, University of Colorado, Brown, Lafayette, Bucknell, Iowa State, University of Maryland, University of Michigan, University of Illinois and Clemson (S. C.) Agricultural.

A few professors expect to spend the summer months at the Schenectady plant. Prof. Valdimir Karapetoff of Cornell University and Prof. J. M. Bryant of the University of Texas will be associated with R. E. Doherty, consulting engineer of the General Electric Company. R. F. Penman and J. H. Skeen, instructors in the department of electrical engineering at Cornell, will make researches in the central-station department.

New York Upstate Companies Draw Closer

Power Corporation Acquires Controlling Interest in Northern New York Utilities—Adirondack Power & Light's Growth —Ithaca System's Program

THE Power Corporation of New York, which owns developed water-power projects at two sites on the Black River and four sites on the Raquette River as well as valuable undeveloped sites, has, it is announced, acquired a controlling interest in the Northern New York Utilities, Inc. The latter company, which as the result of this merger will become the distributing company of the Power Corporation's system, recently acquired the Rome Gas, Electric Light & Power Company and now owns and operates electric light and power properties in Rome, Watertown and more than forty-five adjacent communities. More than 99 per cent of its total electric output is generated at hydro-electric stations, and the company's transmission system will consist, upon completion of lines now under construction, of about 1,350 miles of high-tension lines. It has twelve hydro-electric generating stations on the Beaver, Black and Oswegatchie Rivers with a capacity of 80,925 hp., together with two steam generating plants of 9,775 hp. It is at present seeking authority to develop two water-power sites—one at Soft Maple, on the Beaver River, and the other at Sewall's Island, on the Black River. At Soft Maple a 65-ft. diversion dam and a 120-ft. terminal dam will permit the installation of two 10,000-hp. turbines, the total cost to be $2,370,000. At Sewall's Island, where the site has been acquired from the International Paper Company, 1,250 hp. can be developed, the project being estimated to cost $340,000.

The Power Corporation of New York, through interconnections already existing or under construction, will be in a position to tie into the intercompany system in New York State (see ELECTRICAL WORLD, May 31, page 1147), which includes the Niagara Falls Power Company, Niagara, Lockport & Ontario Power Company, Buffalo General Electric Company, Utica Gas & Electric Company and Adirondack Power & Light Corporation. Over these lines it will be possible to send power as far west as Erie, Pa., and as far east as Boston and Providence. Upon erection of a short transmission line connection can be made with the New York City utilities. The combined valuation of the Power Corporation of New York and the Northern New York Utilities is put at $32,000,000.

ADIRONDACK SYSTEM'S GROWTH

In connection with the increasing interconnection between New York State companies it is interesting to note that approximately three-quarters of the expansion, extension and improvement program authorized by the Adirondack Power & Light Corporation about a year ago is now completed. An addition to the steam plant at Amsterdam is under way which will double its generating capacity from 30,000 kw. to 60,000 kw. A connection from Beardsley Falls on East Canada Creek southward is being made to enable the company to render service to the New York State Gas & Electric Company and affiliated companies, while a westward connection through Oneida and Canastota will connect with the Niagara, Lockport & Ontario Power Company. The Adirondack company has also purchased hydro-electric property at Hadley on the Hudson River in Saratoga County, and it is making a number of miscellaneous internal improvements and alterations including the changing over of the remainder of its system from 40-cycle to 60-cycle operation.

ITHACA COMPANY'S PROGRAM

Further progress in the expansion projects entertained by the New York State Gas & Electric Corporation of Ithaca, N. Y., was made last week when the Public Service Commission of the state heard its petition for permission to extend its lines into towns and villages in Madison, Oneida, Greene, Chenango, Otsego, Ulster, Sullivan and Schoharie Counties. The localities are now served by several small plants, which the consolidation would bring into a unified system. The company desires to build a high-tension transmission line to connect with the Adirondack Power & Light Corporation and will get its power from that corporation. The transmission line will run southerly to Colliers and thence to Delhi, continuing on to connect up the existing lines of the company in Sullivan County. Virtually the only opposition at the hearing came from companies already having rights in a few of the municipalities affected by the application.

All these projects fit in well with the trend toward combination of electric light and power companies in New York State into a few groups of interlocking systems. If the program of the Gas & Electric goes through, as is virtually assured, it will bring energy from the Adirondack Power & Light Corporation, into the middle central and southern tier counties of the state.

Financing the Campaign

Regional Directors and Important Committees Are Appointed to Aid Lighting Extension

DEFINITE plans for completely covering the country in the "better home lighting" activity were made at a meeting of the executive committee on Monday, June 23, by the appointment of regional directors to carry out the campaign in the United States and Canada. In each geographic section of the National Electric Light Association representatives were selected who will spend a great portion of their time from now until the campaign closes in explaining the movement.

These appointments are as follows: L. D. Gibbs, Boston; W. E. Robertson, Buffalo; M. E. Skinner, Pittsburgh; W. H. Wade, Altoona, Pa.; J. E. North, Cleveland; H. A. Brooks, Washington; Charles A. Collier, Atlanta; John F. Gilchrist, Chicago; H. E. Young, Minneapolis; Glen A. Walker, Omaha; Charles W. Davis, Dallas; Clare E. Stannard, Denver; A. C. McMicken, Portland, Ore.; A. Emory Wishon, Fresno, Cal.; F. W. Willcox, Toronto. The field work of the campaign will be conducted under the direction of these men, and the various communities will report to their respective directors.

Field Work Already Done

Considerable enthusiasm was shown by the executive committee over the field work that has already been accomplished by the representatives of the Society for Electrical Development who have been touring the country interviewing the regional directors and the electrical interests in various communities on behalf of the campaign. Some of the cities that have definitely decided to conduct local contests are Denver, St. Paul, Chicago, Atlanta, Grand Rapids, Detroit, Cleveland, Pittsburgh; Buffalo, Newburgh, Poughkeepsie and Kingston, N. Y.; New York City, Boston; Lorain, Elyria, Mansfield, Massillon, Warren, Alliance and Ashland, Ohio, and Windsor, Ontario. Announcement has been made of the appointment of a finance committee whose function will be to raise the money to conduct the campaign. The members of this committee are: W. E. Robertson, chairman; Herman Plaut, J. R. Strong, George F. Morrison, Walter Cary, George E. Cullinan, J. W. Perry and LeRoy Clark, New York; B. E. Salisbury, Solvay, N. Y.; E. A. Gillinder, Philadelphia; H. B. Crouse, Syracuse; John A. Duncan, Chicago; W. I. Bickford, Pittsburgh; V. C. B. Wetmore, Boston, and F. W. Willcox, Toronto.

In order to insure a strict accounting of the money received and disbursed a budget committee was selected consisting of Walter Cary, George F. Morrison and Frank W. Smith. A meeting of the budget committee will be held on July 1 to consider the expenditures that have already been made and to pass on future budgets.

All advertising done in the campaign will be passed upon by a special committee called the advisory advertising committee, consisting of P. B. Zimmerman, J. C. McQuiston and T. J. McManis.

Two new members of the executive committee were selected at the meeting on Monday—Frank W. Smith, United Electric Light & Power Company, New York, and W. E. Robertson, Buffalo. The executive committee plans to meet next on July 17 in New York..

Iowa Men Discuss Range and Refrigerator Servicing

Meeting at the Wahkonsa Hotel, Fort Dodge, the Iowa Section, N. E. L. A., spent Tuesday and Wednesday mornings, June 24 and 25, discussing committee reports and subjects that included domestic electric refrigeration, carrier-current telephony and the home-lighting campaign to be conducted this fall. Ample recreational facilities were provided in the afternoons. More than two hundred attended the banquet.

Joe Carmichael told of his work as director of the Iowa Committee on Public Utility Information, which has resulted in enhanced public confidence in Iowa utilities, helped no doubt by the 700 per cent increase in newspaper advertising in two years.

The technical report prepared by John M. Drabelle, Cedar Rapids, and read by Arthur Huntington, outlined the year's advance toward better economy and spoke of the good results with the 3,500-kw., 3,600-r.p.m. General Electric multiple-stage turbine at Boone operating at a water rate of 12.1 lb.

C. A. Nash, Davenport, urged that more attention be given to the experience of kitchen-unit campaigns before sales be started. He favored the extended development of the house-lighting field, the backbone of revenue.

George A. Lee, Omaha, spoke on legal aspects of the Nebraska law which allow farmers to form a company to purchase wholesale energy from transmission lines and the dangers of this practice unless properly regulated.

Arthur Huntington, Cedar Rapids, reviewed the progress of his rural lines committee by comparing the farmer's advances towards electricity in America and in Europe, where rates are much higher. He dwelt on the work of the National Committee on the Relation of Electricity to Agriculture and said that Iowa now has accepted the Garner rural line for an experimental purpose similar to that of the line at Red Wing, Minn.

At the Tuesday evening informal discussion many operating problems were aired, notably the servicing of ranges. Erroneous ideas concerning this activity were deprecated, many operators telling of having ranges in use with little servicing for more than five years.

H. E. Young reviewed domestic electric refrigeration, declaring that when the present doubts of this equipment are removed the future will hold great developments. He told of installations where service calls were less than one a year.

New officers elected are: President, Don M. Sterns, Humboldt; vice-presidents, John A. Reed, Cedar Rapids, and C. E. Fahrney, Ottumwa; secretary and treasurer, H. E. Weeks, Davenport.

Farmers Want Appliances

Empire State Association's Commercial Section Discusses Rural Lines, Refrigeration and Merchandising

PRACTICAL methods of developing and increasing the use of energy by rural customers were discussed in a paper, "Electricity in New York Agriculture," by H. W. Riley, professor of rural engineering, New York State College of Agriculture, before the annual meeting of the Commercial Section of the Empire State Gas & Electric Association in the auditoriums of the Buffalo General Electric Company and the Niagara Falls Power Company, June 19 and 20. That the farmer is a rather poor "prospect" as a power user was emphasized by Professor Riley in his analysis of the rural-line situation, which showed that what the farmers desire first of all are the electrical conveniences for the home which will lighten the burden of the housewife. After electric lighting has been installed and such appliances as the flatiron, washing machines and vacuum cleaners have been obtained, the rural customer wants water-pumping equipment, a milking machine and probably a small utility motor, provided he has the money to purchase such apparatus.

Sanford J. Magee of Ithaca, president of the association, opened the meeting with an address in which he spoke for privately owned public utilities as against public ownership.

Merchandising Display

A practical demonstration of merchandising display and advertising methods was given by E. F. Newkirk and W. H. Rademacher of the Edison Lamp Works. It was brought out in the discussion of the demonstration that many central-station companies are failing to take full advantage of their window space and display rooms to increase their sales. With every facility at their command, Mr. Newkirk declared, some companies have not installed even adequate illumination in their own show windows.

The second session of the meeting was held in Niagara Falls. T. I. Jones presented a report of a series of tests which he is conducting on a number of household refrigerators. Data collected so far indicate, Mr. Jones said, that these machines will consume between 50 kw.-hr. and 60 kw.-hr. per month and, based on an 8-cent rate for energy, will earn for the central-staion company $213.33 per kilowatt of connected load. This business can be put on the lines without any additional investment cost to a company.

W. R. Huntley, vice-president of the Buffalo General Electric Company, addressed the meeting on "The Commercial Section and the Work of the New York State Committee on Public Utility Information."

W. J. Reagan, commercial manager of the Utica Gas & Electric Company, was elected chairman of the section to succeed H. A. Doering, who has served in that capacity for the last three years. R. V. Howes, assistant commercial manager of the Consolidated Gas Company, New York, was elected vice-chairman.

American Gas & Electric May Buy Binghamton Company

The Binghamton (N. Y.) Light, Heat & Power Company, which is controlled by W. S. Barstow & Company, New York, may very soon be sold to the American Gas & Electric Company, the statement being made that the directors of the Binghamton company are formulating their terms.

R. E. Breed, chairman of the American Gas & Electric Company, which recently, along with the Appalachian Power Company, purchased control of the American Electric Power Company, is reported as saying that if the price proves acceptable the American Gas & Electric can tie the property in with the Scranton (Pa.) Electric Company, an American Gas & Electric subsidiary, and connect its lines with a network of other transmission lines between Scranton and the Pennsylvania - New York border. The American Gas & Electric Company at present does not operate or control any utility properties in New York State. The Binghamton company supplies the entire electric light and power service of Binghamton, N. Y., and several adjoining towns. The population served is more than 135,000, and the company's franchises are unlimited as to time.

Northwest Association Has Record Attendance

Another record convention attendance is reported as the ELECTRICAL WORLD goes to press from Gearhart, Ore., where the Northwest Electric Light and Power Association, as that geographic division of the N. E. L. A. is known, assembled on Wednesday for a three-day session. Franklin T. Griffith, president of the Portland Electric Power Company and the newly elected head of the N. E. L. A.; President George L. Myers of the Northwest association, and Managing Director M. H. Aylesworth addressed the opening session, which was devoted to public relations.

Young Offers League Plank to Democrats

Owen D. Young, chairman of the board of the General Electric Company and colleague of Charles G. Dawes in the recent European reparation conference which resulted in the Dawes report, has become a prominent figure before the Democratic National Convention as General Dawes, because of his nomination for the Vice-presidency, did in the Republican convention. Mr. Young has submitted to the sub-committee engaged in formulating the Democratic platform a plank favoring the League of Nations, of which the following is the salient paragraph:

"The Democratic party favors co-operation with or participation in such agencies, including the League of Nations, as may be helpfully functioning in the social and economic rehabilitation of the world on such terms as will, on one hand, protect the sovereignty and independence of our government and on the other enable it to render its full service and receive its full benefits from the common, and enlightened action of all nations."

The platform had not been reported to the convention when the ELECTRICAL WORLD went to press, but according to newspaper reports, Mr. Young's plank stood an excellent chance of being incorporated in it.

Farm Engineers Discuss Electrification

Representatives of Government Departments, Central-Station Companies and College Faculties State the Problem and Point to Methods of Attack

A RURAL electrification session of the convention of the American Society of Agricultural Engineers in Lincoln, Neb., was held on June 19. Papers presented were: "Some Research Features Involved in the Application of Electricity to Agriculture," by R. W. Trullinger, United States Department of Agriculture; "Electricity in Agriculture Abroad," by P. A. Lundquist, United States Department of Commerce; "The Relation of Water Power to Electrical Development," by G. C. Neff, Wisconsin River Power Company; "Making Electrical Contact with the Farmer," by J. P. Fairbank and E. J. Stirniman of the University of California, and "The National Farm Power Survey," by C. D. Kinsman, United States Department of Agriculture.

Mr. Trullinger's paper covered thirteen divisions as follows: (1) House lighting; (2) house heating; (3) cooking; (4) preparation of food; (5) mechanical operations; (6) electroculture; (7) animal production; (8) dairying; (9) poultry husbandry and egg production; (10) orchard practice; (11) insect pests and hailstorms; (12) drainage and irrigation pumping equipment; (13) miscellaneous. In general, he said, not enough is known of a fundamental nature regarding the exact requirements of the more important processes of specific types of farming to justify immediate electrification of large rural areas.

Mr. Lundquist's paper was a progressive report of the study conducted by foreign offices of the Department of Commerce in Sweden, Great Britain, New Zealand, France, Germany, Holland and Denmark.

The committee on rural power lines reported that nine states—Minnesota, Wisconsin, South Dakota, Alabama, Kansas, Iowa, Virginia, Pennsylvania and New Hampshire—had begun activity in this direction. Statistics showed that 167,000 farms in the United States are now connected to a high-tension line—about 2½ per cent of the total number. In about the same number small isolated plants are used.

The committee on unit farm electric plants reported greater co-operation between salesmen of unit plants and the farmers in the desire of the latter, often impossible to gratify, of service from the large central stations.

Mr. Neff emphasized the fact that the cost of generating electricity is only a small part of the cost of electricity delivered to the customer. The transmission and distribution costs are several times the generating cost in most cases, and therefore attention should be concentrated on that part of electric service which costs the most.

There were more than 93,000 rural domestic consumers of electricity in California in 1923, Messrs Fairbank and Stirniman said in their paper. Of these, 27,000 used electricity for power purposes, and in addition it is found that there are about four thousand unit plants on other farms. The extension program in California is as follows: (1) To add to the farmhouses obtaining electricity; (2) to give general information on electricity as applied to agriculture; (3) to hold wiring schools in communities requesting them; (4) to demonstrate better farm-home illumination by means of lectures with individual follow-up work; (5) to establish practice schools in minor repair and maintenance of electrical wiring and equipment.

To assemble all available data on the sources and uses of power on farms in the United States was given as the purpose of the farm power survey by Mr. Kinsman. The survey was to include collection of all data on number, distribution, size and types of farms; amounts and kind of live stock, kinds of crops with average acreage and yields of each, number and distribution of work animals, various kinds of mechanical power units and number of agricultural workers. The total amount of power used is then to be determined and the amount required for each operation, for the production of each principal commodity and for the operation of various types and sizes of farms.

Griffith Appoints N. E. L. A. Section Heads

According to the revised constitution adopted by the National Electric Light Association at its convention in Atlantic City, N. J., last May, the chairmen of the national sections are no longer elected by the sections but appointed by the president and will form a sort of cabinet for him. Accordingly President-elect Franklin T. Griffith of Portland, Ore., has announced the appointment of the following chairmen:

Accounting National Section—W. Paxton Little, treasurer Niagara Falls Power Company.

Commercial National Section—W. R. Putnam, vice-president and general manager Idaho Power Company, Boise.

Technical National Section—H. P. Liversidge, vice-president Philadelphia Electric Company.

Public Relations National Section—Matthew S. Sloan, president Brooklyn Edison Company.

The personnel of the various national committee will be announced soon.

New Montreal Holding Company Is United Securities

United Securities Limited is the name of the new Montreal holding company which has been sponsored by the Montreal Light, Heat & Power Consolidated and the Shawinigan Water & Power Company. It has already arranged for control of the majority of the stock of the Quebec-New England Hydro-Electric Corporation (see ELECTRICAL WORLD, June 21, page 1298) and is now endeavoring to acquire by exchange the stock of the Montreal Tramways & Power Company. This proposal, it is said, is opposed by some of the board of directors of the last-named company, including President Beauvais, who desire better terms. Shareholders are given until August 1 to deposit their stock with the Montreal Trust Company. For each share they are offered $15 worth of a stock in United Securities, half common and half preferred, the latter with a guaranteed 6 per cent dividend. Those opposing the transfer claim that the Montreal Tramways & Power shares are worth $20 to $25 cash.

Associated Manufacturers Elect Officers

The publication of a handbook on standards was announced at the final session of the Atlantic City convention of the Associated Manufacturers of Electrical Supplies at the end of last week. This publication will be available within a week or two. The final meeting was given over to the reports of officers and standing committees, with an address by David Sarnoff, vice-president of the Radio Corporation of America, who pictured the situation in the radio industry, prophesying that radio sales this year will exceed the total of last year and that those in 1925 will be still larger. International broadcasting, he said, promises rapid development in the near future.

The following were elected to the board of governors of the association: D. R. G. Palmer, J. P. Wright, J. C. Belden, W. L. Hines, H. R. Sargeant, William H. Thornley and B. B. Dinsmore. At the board of governors' meeting following the convention William H. Thornley was elected president of the association and Sears Condit vice-president, and H. W. Bliven was re-elected treasurer.

Attack on Eminent-Domain Clause of Water-Power Act

A vigorous attack on the constitutionality of the eminent-domain provisions of the Robinson state water-power law was made by John P. Morrissey, Assistant Corporation Counsel of New York City, at the final hearing before the New York Public Service Commission last week on an application of the Niagara, Lockport & Ontario Power Company for permission to exercise the right of eminent domain over property along the Salmon River, in the town of Orwell, Oswego County. Mr. Morrissey took the ground that the water-power resources of the state belong to the people and that the matter should be allowed to rest until the state shall undertake a policy of development of power resources for the public good. The decision of the commission on this point, which is expected soon, will possess interest not alone in New York State but throughout the nation, because the provision of law which is attacked was copied into the New York State statute verbatim from the federal law.

The case at issue concerns the first attempt of a private corporation owning 51 per cent of the developed and undeveloped power of a watershed to obtain physical possession and control of the entire potential power.

Arkansas Utility Men Meet

Gathering at Hot Springs Breaks the Record Both in Attendance and in Interest

THE annual convention of the Arkansas Utilities Association, which was held at the Hotel Eastman, Hot Springs, Ark., on June 12-13, President J. L. Longino presiding, was a success from every angle. The 1923 convention was held in Pine Bluff last November, but it was decided to change the meeting dates from fall to spring months for many reasons and especially because manufacturers' representatives, or "Class B" members, could guarantee better attendance in the spring. The convention just held was a record breaker in attendance and also in interest.

The chief addresses were made by C. P. J. Mooney, managing editor of the Memphis *Commercial-Appeal*, and Dr. Henry Mace Payne, consulting engineer for the American Mining Congress, Washington, D. C. Mr. Mooney spoke on development of the South's resources and told of the important part in this work which the public service corporations are doing.

Dr. Payne spoke on "National Problems and State Development." He paid a tribute to the fine service being rendered by utilities to the progress of the South and of Arkansas, and he urged that the country continue to hold its great undeveloped water powers and put them to work only through and under the supervision of the Federal Power Commission.

Another speaker was Earl C. Elliott, city manager of Wichita, Kan., and an officer of the national organization of city managers. Among other things Mr. Elliott said that he is an advocate of private ownership for public utilities unless all politics can be kept out of municipal ownership, which he thought impossible. There were many other good addresses.

The convention enthusiastically indorsed the public relations and goodwill work being done by the Arkansas Public Service Information Bureau and its publication and also went on record as thanking the ELECTRICAL WORLD and other papers in the utility field for their effective work along similar lines. On the last day of the meeting the visitors were entertained at luncheon at the Remmel Dam on the Ouachita River.

Last year's officers were re-elected as follows: President, J. L. Longino; first vice-president, R. C. Coffy; second vice-president, S. R. Brough; third vice-president, A. E. Main; secretary and treasurer, Rex I. Brown. The association will hold a joint meeting next year with the Southwestern Geographic Division of the National Electric Light Association at Hot Springs in May.

Commission Again Frowns on Huntsville-Shoals Line

The Alabama Power Company's petition to build a 44,000-volt transmission line at a cost of about $500,000 from Decatur, Ala., to Hapgood, near Muscle Shoals, has been granted by the Alabama Public Service Commission. The commission at the same time again denied a petition of the same company to build a 110,000-volt line from Huntsville, Ala., to Muscle Shoals. It will be remembered that the company sought a permit for the Huntsville line last year, in order to complete a transmission line ring between its properties in northern Alabama. This proposal, however, will be served by the line to Hapgood. Hapgood is near the northern terminus of the line from the Gorgas steam plant. The power company was also authorized to build a line to a rock-asphalt plant at Cherokee, Ala., and a line to Russellville, Ala.

In granting the petition, the commission took the ground that a certificate of convenience and necessity to a utility does not constitute an exclusive franchise or right to render the particular service in such territory. The commission also declared that the building of the 44,000-volt line had no bearing whatever on the leasing of Muscle Shoals, a question which is before Congress for settlement. The new line will supply 3,000 hp. to a new cotton mill at Huntsville, Ala., as well as serve other industries in the Tennessee Valley.

Seattle Halts Municipal Plant

The Skagit River project of the city of Seattle will be halted indefinitely after completion of the Gorge Creek unit next month as the result of a resolution adopted by the Seattle City Council over the protest of the Board of Public Works and Mayor Brown. The suspension of the work on the Skagit plant will mean shelving temporarily plans for a five-million-dollar masonry dam at Gorge Creek and for storage development work on Ruby Creek. The Council in passing the resolution made it plain, however, that the abandonment of work was only temporary and that construction would be resumed when time was opportune.

Between $150,000 and $200,000 more will be required to complete the Gorge Creek unit, according to City Engineer Blackwell. Mayor Brown declares that this unit will be completed "well within the original estimate of $11,000,000." He recommends not only the early construction of the second unit of the project but also the purchase of the transmission lines of the Puget Sound Power & Light Company within the city limits, preferably through condemnation proceedings.

Briefer News

Iowa Contractors Organize.—Fifty electrical contractors and dealers from twenty-four Iowa cities have formed the Iowa Association of Electragists. E. B. Murray of Fort Dodge was elected president, Robert Honeger of Des Moines vice-president and C. E. Gourley of Cedar Rapids secretary-treasurer.

Ohio River Power Company Takes Over Three Plants.—The Ohio River Power Company has been authorized by the Ohio Public Utilities Commission to take over the properties of the Ohio River Electric Railway & Power Company, operating between Gallipolis, Pomeroy and Middleport, at a price of $477,570.

Building Dix River Dam.—An idea of the magnitude of the Dix River hydro-electric development under way for the Kentucky Hydro-Electric Company will be spread widely by motion pictures taken recently when 90,000 lb. of dynamite was exploded at the site of the dam and brought tumbling down a 300-ft. cliff, thus providing about 75,000 cu.yd. of rock for the structure. Work is being pushed day and night on this dam, which will impound a lake 36 miles long.

North Coast Power Company Passes.—Official announcement has been made of the passing of the old North Coast Power Company of Chehalis, Wash., which controlled the light and power business of southwest Washington for several years. The company was merged with the Puget Sound Light & Power Company some months ago, but the old name was not discarded until June 10. There is no change in the personnel of the officials in charge, W. A. Schoel continuing as district superintendent.

El Paso System Expanding.—As a part of its plans for extending its electric power system to include towns and industries of the upper valley of the Rio Grande, the El Paso Electric Railway Company has, as foreshadowed in these columns on May 10, purchased the plant of the Las Cruces (N. M.) Electric Light & Ice Company. It is stated that the purchase price of the plant, including the cost of installations that are to be made, totals $275,000. The El Paso Electric Railway Company, which does a light and power business, is controlled by Stone & Webster.

Pennsylvania Commission to Investigate Sale of American Electric Power Company.—The Pennsylvania Public Service Commission is to investigate on its own motion the recent transfer of the common stock of the American Electric Power Company to the American Gas & Electric Company of New York and the Appalachian Power Company of Bluefield, W. Va. (See ELECTRICAL WORLD, June 7, page 1198.) The commission announces its desire to know what caused the great advance in the price of the stock and also whether the subsidiary companies are receiving satisfactory service since the transfer.

An Iowa-Missouri Link.—Thirty-five miles of 33,000-volt line which will tie in the two companies is being built by the Lee Electric Company, which operates in fifteen southwestern Iowa towns, and the Maryville Electric Light & Power Company, which serves twenty towns in northwest Missouri. Both companies are subsidiaries of the Continental Gas & Electric Corporation. The new line, which will run from Clarinda, Iowa, to Maryville, Mo., will give the Maryville system a connection with all the plants of the Lee Electric Company and Iowa Service Company, as well as with the Nebraska Power Company, Omaha. Many improvements are being made at both the terminal plants to take proper care of the new line.

Indiana Fight Goes Merrily On.—The Indiana Supreme Court has granted the Terre Haute, Indianapolis & Eastern Traction Company a temporary restraining order against the Indiana Electric Corporation preventing it from running its Terre Haute-Indianapolis power transmission line across the traction company's right-of-way, for which, as recorded last week, authority was granted it by the Superior Court in Indianapolis. The latter court has appointed appraisers to estimate the damage done. The traction company declares that damage through electrostatic and magnetic disturbances cannot be estimated equitably by the appraisers and that the power lines will disturb the telephone lines over which train dispatchers have right-of-way.

Coming Meetings of Electrical and Allied Societies

[A complete directory of electrical associations is published in the first issue of each volume. See January 5 issue, page 72, for latest list.]

Ohio Electric Light Association—Hotel Breakers, Cedar Point, Ohio, July 8-11. D. L. Gaskill, Greenville, Ohio.

East Central Division, N. E. L. A.—Cedar Point, Ohio, July 9. L. B. Herrington, Kentucky Utilities Co., Louisville.

Mississippi Electrical League—Gulfport, Miss., July 14-15.

Pacific Coast Electrical Supply Jobbers' Association—Del Monte, Cal., July 24-26.

Pennsylvania Electric Association—Bedford Springs Hotel, Bedford Springs, Pa., Sept. 3-6. H. M. Stine, 212 Locust St., Harrisburg.

Association of Edison Illuminating Companies—Griswold Hotel, New London, Conn., Sept. 8-12. P. S. Millar, 80th St. and East End Ave., New York.

Michigan Electric Light Association—Detroit, Sept. 9-11. Herbert Silvester, Edison Bldg., Ann Arbor, Mich.

New England Division, N. E. L. A.—Hotel Wentworth, Portsmouth, N. H., Sept. 10-13. Miss O. A. Bursiel, 149 Tremont St., Boston.

Rocky Mountain Division, N. E. L. A.—Hotel Colorado, Glenwood Springs, Col., Sept. 15-17. O. A. Weller 900 15th St., Denver.

Southeastern Division, N. E. L. A.—Birmingham, Sept. 15-18. E. T. O'Connell, Alabama Power Co., Birmingham.

Great Lakes Division N. E. L. A.—French Lick, Ind., Sept. 24-27. R. V. Prather, Illinois Mine Workers' Bldg., Springfield, Ill.

Ford to Electrify His Railroad.—Construction of the first electric locomotive for Henry Ford's Detroit, Toledo & Ironton Railroad will be started on July 15 in the shops of that railroad at River Rouge. The engine is designed to utilize high-tension power from an overhead circuit and to carry its own transformer, thereby obtaining the economies of both direct and alternating current without the disadvantage of either. It will be 117 ft. long, weigh 340 tons and have a tractive effort of 200,000 lb. It is designed especially to handle large shipments of coal. The complete electrification of the road is said to be in view.

New Million-Dollar Hudson River Power Plant.—Marking the completion of another unit in the ultimate development of the water-power resources of the upper Hudson River, the International Paper Company has placed in operation a new million-dollar power plant at Feeder Dam, 3 miles north of Glens Falls, N. Y. The plant is owned by the Moreau Manufacturing Company, which is composed of officials of the International Paper Company, Finch-Pruyn & Company, Inc., and the Adirondack Power & Light Corporation. It will feed the interconnected power system between Niagara Falls and Boston.

Colorado Power Rates Again in Issue.—The mine operators of Colorado are asking the Public Service Company of Colorado, which recently absorbed the Colorado Power Company, for a reduction in rates. It will be remembered that the Colorado Power Company, after a four-year fight, succeeded before the United States District Court at Denver last January in obtaining a decision declaring confiscatory the rates that then existed and increasing the Public Service Commission's valuation of the company's property by more than 100 per cent. The miners now claim that many mines were forced to shut down by the increase in rates that followed this decision and that many others are on the verge of quitting because they cannot operate without electricity and cannot pay the present price. A conference between representatives of the company and the mine operators will be held.

Columbus (Ohio) Railway, Light & Power Taken Over by Continental Gas & Electric.—Another noteworthy merger in the Middle West was accomplished last week through the acquisition of a controlling interest in the Columbus (Ohio) Railway, Light & Power Company by Cyrus S. Eaton of Cleveland, chairman of the board of directors of the Continental Gas & Electric Corporation. Five months ago, it will be remembered, the Continental company acquired a controlling interest in the Kansas City Power & Light Company. The present executive officers of the absorbed company, it is announced, will not be disturbed. The

Columbus Railway, Light & Power Company, as it name implies, has operated the trolley lines of the Ohio capital as well as furnished it with light and power. Its total rating at its four city generating stations was 85,100 kw., and it also purchased energy. It had outstanding more than $6,000,000 in common stock, more than $7,000,000 in preferred stock and $16,000,000 in bonds.

West Missouri Power Company Now Serves Fifty-nine Towns. — The West Missouri Power Company has purchased the Fort Scott & Nevada Light, Heat, Water & Power Company of Nevada, a city of 8,000 population, and the Sac River Power & Light Company, which has a hydro-electric plant on the Sac River near Caplinger Mills and serves Humansville, Caplinger and Flemington. The West Missouri Power Company will, it is stated, spend $200,000 on further developments of the Sac River property. The recent additions will bring the number of towns served by the West Mississippi Power Company to fifty-nine. These properties extend from within a few miles of Kansas City to Nevada on the south and almost to Sedalia on the east.

Edison Stock Drive Directed by L. A. Ferguson.—An intensive campaign for the sale of Commonwealth Edison stock is being held at Chicago, the dates set being from June 16 to July 3. This campaign is known as the Louis A. Ferguson drive. Mr. Ferguson was selected as sponsor because of his direct interest in the company's construction program, for which purpose these funds will be used. Bonus and prize money plans are in force, and wherever possible employees are allowed to take time off to interview friends and close sales. A special sporting and financial edition of the *Drive Week Daily* keeps the employees informed of the progress of the sale.

New Officers of Georgia Electrical Association.—At the annual convention of the Georgia Electrical Association, held in Atlanta on June 18 and 19 and reported last week (page 1297), the following officers were elected for the coming year: President, J. E. Mellett, vice-president J. M. Clayton Company, Atlanta; vice-president, Henry Morton, Columbus; secretary and treasurer, W. W. Barr, Atlanta. Mr. Mellett and Mr. Morton were re-elected. The executive committee will include Morton Frierson, Savannah; J. H. McNeil, Augusta; C. L. Ludwig, Dublin; R. H. Scott, Atlanta; L. E. Landers, Valdosta, and T. S. Sloan, Macon.

A Superpower Plan for Washington State. — Advocating a "superpower" system of hydro-electric transmission and the creation of a permanent state water power commission to formulate plans for such a system, Carl Edward Magnusson, professor of electrical engineering at the University of Washington in Seattle, has prepared a bulletin printed by the university entitled "Hydro-Electric Power in Washington." Taking the United States Geological Survey's estimates as a basis for computation, the report places the maximum water power available in the state at 8,647,000 hp., or 16.04 per cent of the entire amount in the United States. A list of potential sites capable of developing from 10,000 hp. to 750,000 hp., eighty-eight in number, has been prepared. The superpower system as outlined would tie in all generating plants to a main line running from Sumas to the Columbia River on the south and two east and west trunk lines, one running from Puget Sound in the Ellensburg-Yakima direction. A fourth line would connect with the Columbia River projects. Steam auxiliaries at coal mines to aid water shortages are advocated.

Canadian Engineers at World Power Conference.—A party consisting of about twenty-five Canadian engineers has sailed to take part in the World Power Conference at London, which opens next week. This delegation will be far greater than Canada's proportion of population, owing to the Dominion's advanced position with regard to the application of power to industry. The majority of the Canadian delegates will be representative of the Canadian use of hydro-electric power, and papers on this subject will be presented by a number of Canadians, including several Montreal electrical engineers. These papers include: "The Water Powers of Canada, Their Nature, Extent and Administration," by J. B. Challies, Ottawa; "The Fuel Resources of Canada and Their Utilization for the Production of Power and Other Purposes," by B. F. Hanel, Ottawa; "The Generation of Hydro-Electric Power in Canada," by Julian C. Smith and Prof. J. C. Christie, Montreal, and "The Utilization of Power in Canada," a symposium prepared under the direction of P. T. Davies, Montreal, and comprising ten short papers.

Kewanee's New Municipal Plant Sold to Private Operator at Beloit, Wis.—By a vote of 5,800 to 2,117, the citizens of Kewanee, Ill., on June 14 approved the sale to B. F. Lyons, vice-president and general manager of the Beloit (Wis.) Water, Gas & Electric Company, of the Kewanee municipal electric plant, which had been placed in operation the week before. The plant would have operated in competition with the electric light and power plant of the Consolidated Light & Power Company, now supplying service to Kewanee, which has a population of 16,000. Along with this acquisition Mr. Lyons plans to purchase the privately owned electric and gas plants, the Kewanee street-railway system and the interurban railway connecting Kewanee and Galva, Ill. The whole transaction will involve a sum upward of $2,000,000. Transfer of the properties will take place within thirty days. The Kewanee Public Service Company will be organized with headquarters at Beloit. The so-called "Lyons plan" of consolidation and purchase has been before the voters of Kewanee for more than six months, and the special election took place after an intense campaign for and against the proposal.

Men of the Industry

Changes in Personnel
Accomplishments, Responsibilities, Honors, Appointments and Activities of Men Engaged in all Branches of the Electrical Industry

Charles A. Coffin, founder of the General Electric Company, was recently honored by Princeton University with the degree of doctor of laws.

William Le Roy Emmet, consulting engineer General Electric Company, received the honorary degree of doctor of science from Trinity College last week.

E. R. Berry, assistant director of the Thomson Research Laboratory of the General Electric Company at West Lynn, Mass., was recently awarded the honorary degree of doctor of science by the University of Maine.

Richard E. Downing, for the past two years instructor in electrical engineering at the University of Maine, has been appointed assistant engineer of the Maine Public Utilities Commission.

Frank T. Singleton of Martinsville, Ind., has been appointed a member of the Public Service Commission of Indiana, the appointment to take effect July 1. Mr. Singleton succeeds Oscar Ratts, whose term expired recently.

Willard D. Sims has been appointed superintendent of the Comerio hydro-electric plants of the Porto Rico Railway, Light & Power Company, succeeding Frederick Krug, who has been advanced to the position of superintendent of power production. Mr. Sims was until recently connected with the electrical department of the city of Orlando, Fla.

R. H. Filbeck was elected president of the Terre Haute (Ind.) Traction & Light Company at the recent annual meeting of the board of directors.

E. J. Brabant, formerly connected with the Illinois Tax Commission and more recently public utilities statistician for the Wisconsin Tax Commission, has tendered his resignation from that body in order to enter private practice in Madison, specializing in tax questions.

Owen D. Young, chairman of the board of directors of the General Electric Company, received the honorary degree of doctor of laws from Harvard University last week. Within a week three Eastern colleges conferred this degree upon Mr. Young, Tufts and Dartmouth completing the trio.

H. A. Carmichael has been elected treasurer of the Westinghouse Electric International Company to succeed F. L. Townsend, who died some time ago. Mr. Carmichael entered the employ of the Westinghouse Electric International Company in May, 1917, as correspondent in the New York treasury and ac-

counting department of the company, and in October of that year he was put in charge of collections in that office. Three years later he assumed charge of general credits and collections for the International company, subsequently being appointed acting assistant treasurer and then assistant treasurer. He held the position of assistant treasurer until his recent promotion.

G. O. House Heads North Central Association

Garrett O. House, the new president of the North Central Electric Association and manager of the St. Paul Division of the Northern States Power Company, was born in Haverstraw, N. Y., in 1870. He received his education in the public schools at Haverstraw and at Phillips Exeter Academy. Mr. House first obtained employment

G. O. HOUSE

in 1889 in an engineering capacity on the Poughkeepsie (N. Y.) Bridge, a cantilever structure crossing the Hudson River. From then on he held various engineering positions until 1901, when he became associated with the American District Steam Company in Lockport, N. Y., as construction engineer. There he supervised the installation of some of the largest underground central-station steam-heating distribution systems in the United States, including one at St. Paul. In 1906 he became secretary and general manager of the Northern Manufacturing Company, a predecessor of the present Northern States Power Company. When in 1909 the management of that company was taken over by H. M. Byllesby & Company, Mr. House resigned to become connected with the Northwestern Fuel Company in the construction of electrically equipped coal docks at Duluth and Superior. In 1912 he became general superintendent of the St. Paul Water Works, retaining that position until May, 1918, when he became superintendent of the St. Paul City Railway Company. In August, 1918, he left that organization to become manager of the St. Paul division of the Northern States Power Company, which position he now holds. Mr. House has always taken a prominent part in association work and civic enterprises of importance.

J. Stanley Brown has resigned from the Phoenix Utility Company, New Orleans, to become electrical designer with Dwight P. Robinson & Company, Inc., at Seal Beach, Cal.

George Bennett, formerly connected with the South Bend properties of the Northern Indiana Gas & Electric Company, has been placed in charge of the company's properties at Plymouth, Ind.

Fred J. W. Luck is now territorial manager with the Westinghouse Electric International Company, London, England. Mr. Luck was formerly special representative in Rio de Janeiro, Brazil.

Frank W. Bedard, formerly division manager of the Illinois Power & Light Corporation at Champaign, Ill., has relinquished the duties of that position to enter a broader field of endeavor created by the general offices of the company for the promotion of gas sales for industrial purposes and house heating.

Emil A. Roehry, for the last six years manager of the Cairo (Ill.) Railway & Light Company, has been promoted to be division manager of the Illinois Power & Light Corporation's properties at Champaign, Ill., to succeed Frank W. Bedard. The Cairo utility is controlled by the Illinois Power & Light Corporation.

Henry C. Walter has recently been made engineer in charge of direct-current design with Fairbanks, Morse & Company, Indianapolis. Mr. Walter was formerly in the engineering department of the Allis-Chalmers Manufacturing Company.

G. L. Wilder, railway specialist of the International General Electric Company at Schenectady, left June 7 for a several months' trip to Cuba and Mexico. Mr. Wilder will co-operate with the General Electric Company of Cuba and the Mexican General Electric Company in expanding their facilities for service to steam and electric railways and public utilities. He will also represent the merchandising and publicity departments of the International General Electric Company.

William R. Bell, sales manager of the Haverhill (Mass.) Gas Light Company for approximately four years, has been made sales manager of the El Paso (Tex.) Electric Railway Company. Mr. Bell has been associated with the Stone & Webster organization since his graduation from the Rose Polytechnic Institute at Terre Haute, Ind., first being assigned to Paducah, Ky., his home town, and later to Baton Rouge, La., where he was made sales manager. He left Baton Rouge to go to Haverhill.

Dr. Leonard F. Fuller, prominent radio engineer and for the past year and a half identified with the General Electric Company at Schenectady, N. Y., has been appointed vice-president of the R. E. Thompson Radio Corporation and vice-president and chief engineer of the R. E. Thompson Manufacturing Company of Jersey City, a subsidiary company. Dr. Fuller, who has been a consultant on radio engineering for several years, was awarded the Morris Liebmann prize for 1919 in recognition of his research and development work in this field. He will assume his new duties on July 1.

H. G. Butler Again Appointed Power Supervisor

H. G. Butler, consulting engineer of San Francisco, has been appointed power supervisor of California by the California Railroad Commission to regulate the distribution of power in co-operation with the power companies during the period of the drought, which will probably not terminate before November. In a similar emergency four years ago Mr. Butler acted as power administrator of California, so that the utilities in the present acute situation will benefit from his acquired experience. Mr. Butler was graduated from

H. G. BUTLER

the University of Illinois in 1906 and for several years was identified with railroads in the Middle West. In 1911 he went to Panama for the government, where he assumed charge of the railroad yards during the construction of the canal. Upon its completion he joined the California Railroad Commission, with which he was associated until 1921, when he resigned to engage in consulting engineering work with offices in San Francisco.

Obituary

Ezra Phaneuf, proprietor of the Electric Machine & Instrument Company, Boston, died recently at Arlington Heights, Mass. Mr. Phaneuf was born in Adamsville, Canada, fifty-five years ago.

Edward D. O'Brien, who has been assistant superintendent of public utilities at Seattle for the past five years, died there recently at the age of fifty-one years. Mr. O'Brien had been in the service of the city since 1909. He was a graduate of the Armour Institute of Technology in electrical engineering and was also a lawyer.

Commission Rulings

Reasonable Demand for Service and Probability of Return Must Be Shown Before Extension of Service Is Made Obligatory.—The Crystal Springs Land Company and certain interveners sought an order from the Virginia Corporation Commission to force an extension of service by the Roanoke Waterworks Company to their property in a new suburban development. The commission refused to issue the order, saying: "The most that can be said in favor of the amended petition is the statement that the Crystal Springs Land Company may from time to time build houses on the property now being developed, it being in the locality where this service is desired. Not that much can be said for the petition of the interveners. It is a well-established principle of public utility law that while public service companies, when accepting franchises, contract to furnish all the inhabitants within the limits of the chartered territory such services as are reasonable and proper, nevertheless facilities for the extension of service cannot be required to be made unless there is a reasonable demand for the extension with a reasonable return in prospect."

Unfair to Raise Rates for Domestic Service After Customer Has Made Large Investment Based on Low Price.—In endeavoring to establish uniform rates over the system of the Idaho Power Company except for irrigation pumping load, the Idaho Public Utilities Commission found that the company had built up a domestic water-heating load at a low flat rate per month. The flat rate in one part of the territory served was different from the flat rate in another part of the territory. At the solicitation of the company many had installed electric ranges for cooking purposes, thus doing away with the coal range, and at the same time installed electric heaters for use in providing their homes with hot water. In some instances customers installed electrical appliances at a large expenditure and now use electricity for light, cooking and water heating. "After building up this business," the commission said, "the Idaho Power Company comes to this commission requesting a rate to become effective which on a kilowatt heater, if run continuously, would cost $10.80 per month—several times the cost upon which this business has been established. Evidence introduced at the hearing tended to show that a considerable number of water heaters have been installed by reason of the low rate existing on this class of service. The consumer's investment in utilization equipment having been made under a low flat rate, the commission feels that it would be inequitable to require the customers whose premises have been equipped for this class of service to be changed abruptly to the meter rates filed by the company. On the other hand, it appears that the cost of generating and distributing power for this class of service is greater than the rates now in force, and that the system of flat rates is productive of waste of power. However, even to those customers who have already installed equipment this service has a reasonable value. The evidence before the commission is to the effect that the reasonable value of this service exceeds the present flat rate. It is the opinion of the commission that the conditions and circumstances justify a different schedule of rates for those whose premises have been equipped for this class of service as compared with those who hereafter make such installation. For these reasons the commission believes that for customers who have had their premises equipped for this class of service prior to the date of this order a rate of 6 mills per kilowatt-hour with a minimum monthly charge as set forth in the schedule of rates should be made, and for future customers the rate of 1 cent per kilowatt-hour for all energy consumed with a minimum monthly charge as set forth in the schedules."

Recent Court Decisions

Company Attaching Its Poles to Mill Must Exercise High Degree of Care Toward Workmen on Mill.—It has been held by the Supreme Court of Missouri in Choka vs. St. Joseph Railway, Light, Heat & Power Company, a suit for damages because of the death of a workman from electric shock, that where an electric company, by consent of a milling company and for mutual convenience of both companies, fastened its poles by cross-arms to a corner of the mill and installed high-voltage wires therefrom in and around the building, it was bound to exercise the highest degree of care to prevent injury to anticipated workers having the right to be in and around its wires. The court therefore affirmed judgment for the plaintiff, whose husband, a tinner, was killed through coming in contact with uninsulated "dead ends" of wire while he was sitting on one of the company's cross-arms to repair an eavetrough on the mill. (260 S. W. 67.)*

Navigable Streams and Ownership of River Bed.—In James River & Kanawha Power Company vs. Old Dominion Iron & Steel Corporation, a proceeding to establish the boundary line between the property of coterminous owners, the trial court held that the bed of James River, under which most of the property in dispute lay, has been ever since the establishment of the Commonwealth of Virginia incapable of private ownership. The plaintiff insisted that the ownership of the bed of the river was not involved in cases cited as precedents, that the river is not navigable in law or in fact at the point where the lands of the plaintiff adjoin those of the defendant, that the right of navigation secured by the statutes referred to did not affect the ownership of the bed of the stream, and that, as the tide did not ebb and flow at the point where ownership was in dispute, the common-law rule prevailed and a grant of land bounded by the river extended to the center of the stream. The Supreme Court of Appeals in Virginia affirmed the lower court's decision in so far as it denied title to any portion of the river bed, though maintaining that the Legislature may dispose of the beds under navigable waters, subject to the maintenance of navigation and other public rights. (122 S. E. 344.)

Duty of Power Company to Protect Customer's Premises Against Lightning.—Cox vs. Tripp was an action against the receiver of the South Carolina Light, Power & Railways Company to recover damages for the destruction of plaintiff's cotton ginnery by fire caused by lightning. Defendant claimed that the power company had agreed with him to protect his building against lightning by protective devices at the point of connection between the power company's wires and the customer's cable, and that, in reliance on such agreement, he took no measure for his own protection. The United States Circuit Court of Appeals found that all of the electrical appliances for the reception of the current within the plaintiff's plant were supplied by him, and therefore the defendant assumed no responsibility for any defect in such appliances or their management; thus for protective devices or lack of them inside his plant, and for the outside connection with the power company's wires, plaintiff alone was responsible. The power company, however, the court found, contracted with the plaintiff and undertook to carry current from its pole 18 ft. from plaintiff's building to the end of plaintiff's wires and connect with them. For protective devices from its own plant to the connection with plaintiff's cable the power company was responsible, and if the fire loss arose from its failure to use due care in providing such devices, it was liable. The power company in discharging this duty was chargeable with the high degree of care commensurate with the danger from electricity. The power company at the beginning placed fuse plugs at the point of connection. It is true that its officers testified that these were not meant to protect plaintiff's property, but its own, and that its experts testified they were of little if any value as a protection against lightning. According to the testimony of Cox and other witnesses, however, all the fires occurred after the fuses were taken out and an unbroken copper-wire connection made. The ultimate and vital issue of fact was whether the superintendent of the power company's electrical department acknowledged or assumed for it the obligation to supply protective devices and failed to do so. Here the evidence was contradictory, and it was for the jury to decide. Verdict for the plaintiff was therefore sustained. (296 Fed. 587.)

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

Manufacturing and Markets

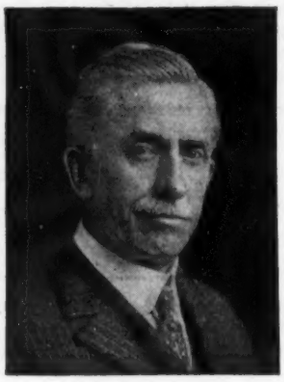
Devoted to the Discussion of Business and Economic Problems of the Producer and Distributor, with Market Reports, Trade Activities, Foreign and Construction News

When Are Tools and Patterns Obsolete?

Progress of Electric Motor Industry Throws Increasing Burdens Upon Manufacturers—Customer Can Aid by Giving Manufacturer His Order for Parts

By Fred M. Kimball
Manager Small Motor Division, Industrial Department, General Electric Company

MILLIONS of dollars' worth of tools, jigs and patterns have been designed, manufactured, utilized and retired from service by the electric motor manufacturers of this country within the past two decades in response to the demands of progress in this rapidly growing industry. These heavy outlays are warranted for the most part, but there is a phase of the matter which should receive more general consideration in relation to the national trend toward eliminating excess varieties in electrical products and toward a better understanding of the importance of standardization in lowering costs to the manufacturer and so to the consumer. I refer to the practice of maintaining obsolescent tools, etc., in factories long after the equipment for which this working paraphernalia was designed has been withdrawn from standard lines of production.



F. M. Kimball

Responsibility of the Manufacturer

It is a widely accepted principle in modern industry that the manufacturer assumes a considerable degree of responsibility for being prepared to furnish at reasonable prices and on prompt deliveries such unusual repair and supply parts of equipment built and marketed by him as will probably be required by his customers. Most manufacturers recognize this implied obligation and endeavor to meet it as a part of their service. However, as the years have passed in the electric motor industry more and more tools and patterns have been removed from active service and have gradually accumulated in what might be called dead storage. These former necessities to manufacture may have been retired from the capital account in some companies and held in it in others, but in either event their retention on a manufacturer's premises adds to his space overhead, represents without doubt acres of floor area in the electrical industry which must be maintained for service of decreasing value to the industry as a whole, and so in the long run is a burden upon the consumer as well as upon the manufacturer.

Progress Should Not Be Penalized

The longer the period of retirement for a given investment in tools and patterns fit only for use in manufacturing obsolete motors and control equipment, the more it must cost the producer and the consumer to have these facilities held in readiness for service. Hence the consumer who is willing to purchase standard motors instead of renewing out-of-date units beyond a reasonable useful life tends to reduce his own costs and those of the manufacturer. In proportion as the latter is active and progressive in adopting improvements and in increasing his lines, the greater becomes his difficulty and expense in providing and keeping up service to his customers if they demand parts and units perhaps of obsolete equipment on cost and delivery terms at all comparable with those in vogue for the standard lines of product.

American motor manufacturers have been most liberal in this matter of maintaining obsolete tools and patterns for the convenience of customers. There appears to be no established policy as to limiting the period of retention, and a search of their pattern storage buildings would undoubtedly reveal patterns still held against possible demand a quarter century or more beyond their useful life. In my own company this would include patterns for old form "D" bipolar motors, some of which are still running after a generation of service. Without a costly investigation it would be very difficult to estimate the overhead expense to this industry of maintaining obsolete tools and patterns for the reproduction of discarded designs of motors, but there is no question that this amounts to tens of thousands of dollars annually.

When to Scrap the Obsolete

Broadly speaking, American motor manufacturers usually make provision for the prompt supply of repair parts for periods ranging from three to five years beyond the time at which such machines have been superseded, and nearly all are prepared to furnish such parts for an indefinite period after the machines themselves are no longer manufactured, but on such equipment and at such prices as are applicable to job work. So far as this matter has been discussed in the industry and as brought out in a paper presented at the Electric Power Club at Absecon, N. J., May 25-29, 1924, by a committee on obsolescence and accepted by the club, the opinion is fairly general that the more bulky patterns and tools, if not specially expensive or complicated, and motor frame patterns in general, need not be kept more than two or three

years after a given type has become obsolete, and it may easily take a half year to "close out" a line after normal production arrangements have been completed for a successor. The above period applies as well to generators and control apparatus.

It is not an unfair assumption that if the owner of a motor or a generator has charged off adequate depreciation from year to year he should be in a position to purchase new and up-to-date equipment when the old has become obsolete. While some motors under extremely severe service last perhaps only five or six years, many have been in use four times that period, and even allowing for obsolescence in addition to wear and tear, it is conservative to estimate that under average conditions, with ordinary care, a motor should last twelve or fifteen years.

On this theory it may be reasonable to expect a manufacturer to supply repair and renewal parts promptly and at prices based on manufacturing in reasonable quantity from three to not over five years after a line is superseded. The highest standards of service also seem to require that the manufacturer should further be prepared to furnish renewals on the basis of longer deliveries and at prices proportional to the cost of producing out of the regular line, until at last the demands for renewals virtually disappear for the particular line in question as a result of the final wearing out or scrapping of the machines from service.

COST OF NON-STANDARD PRODUCTION

No general figure can be given as to the increased cost of furnishing obsolete parts or units after tools and patterns have been disposed of, but in some cases it may easily run between 25 and 1,000 per cent above standard costs. Such a range will be no surprise to a modern manufacturer, but it will doubtless seem extraordinary to some purchasers and users of equipment. It should be realized that present-day prices prevailing for motors of good quality would be absolutely impossible were it not for mass production. A change in design of even a few thousandths of an inch may render obsolete tools valued at many thousands of dollars. The moment one breaks away from volume production in manufacturing a machine like an electric motor with its four score or more different pieces, that moment costs leap skyward. A slight change in the design of a commutator may take the engineer back to the bar fabrication shop and create an amazing amount of trouble before a new normal production rate can be attained. If the reproduction of an obsolete part or unit involves chiefly material rather than labor, the cost will in general be much lower.

The case for standardization grows stronger as each year passes, and while there will doubtless be a sizable demand at all times for obsolete parts in this industry, the recognition by users of the fairness of providing these on a commensurate scale of costs will result in savings of worth-while magnitude to manufacturers and their customers.

Stopping the Leak in Storage-Battery Advertising

How Extravagant Statements Debauched the Market—Advertising Men's "Vigilance Committee" Acts in Interest of Truth in Publicity

BY ROBERT E. HUTCHINSON
Associated Advertising Clubs of the World

THE increased production of automobiles and the phenomenal growth of the radio industry have had a similar influence in the electric storage-battery field. Rapid turnover has encouraged many manufacturers to turn to storage batteries, and as a result the older manufacturers who were operating in the field have felt the keenest competition. Necessarily, such products offered the public have been of varying degrees of efficiency, and the advertising for these products has been of an equally wide variety.

With attacks upon the dictionary on all sides to supply superlatives and flattering adjectives, the situation for a time took the aspect of a poker game. One manufacturer hit upon the idea of offering an unconditional guarantee for six months with each of his batteries. He was immediately "called" and raised six months by Manufacturer No. 2. No. 3 fell in with the spirit of the occasion and established a guarantee of three years—and so on until five-year limits were reached.

However, unlike the game where imaginary sums are wagered with no thought of their being paid, the day of reckoning came. It was found in many cases that batteries would not stand by their guarantees, with the result that many dealers and manufacturers defaulted on their terms or went out of business. Others, offering an unconditional guarantee, were found to be actually warranting their batteries on such restricted and qualified conditions as to make the so-called "guarantee" practically worthless.

Closely following and paralleling the exploitation of batteries came the vendors of battery solutions, offering the products of patented and secret formulas which were claimed to possess the power to charge batteries instantly by merely replacing the electrolyte and to make a battery immune to the usual battery troubles, such as plate buckling, excessive sulphation, corrosion, freezing, overcharging and overheating.

Not only were such solutions grossly misrepresented, but very frequently they were of a character to shorten the life of the battery into which they were injected, if they did not ruin it outright. Substitution of both batteries and parts or passing them off for something other than they are were prevalent in many localities, and conditions were reached where the legitimate battery advertiser, dealer, distributor and manufacturer felt the serious effect of unfair competition. The average motorist has never fully understood what goes on inside a storage battery, and the effect of these malpractices was to increase his bewilderment.

VIGILANCE COMMITTEE ACTS

In an effort to stop the leak in storage-battery advertising, the national vigilance committee of the Associated Advertising Clubs of the World has launched a definite campaign against all the misstatements and exaggerations that have characterized it. General educational bulletins have been issued to manufacturers and battery service stations throughout the country, calling attention to the gravity of the situation and voicing a warning that continuance of such practices will lead to chaos in the industry. Manufacturers advertising unfounded and impossible claims for their products are being called upon by "better business bureaus" and representatives of the national vigilance

committee to verify them, and upon failing to do so are asked to remodel their language in line with the actual facts.

Experiments have been conducted by the department of technology of the national vigilance committee to show that it is impossible to recharge a battery instantly, or to make it immune to abuses, merely by adding a chemical solution. Guarantees given by various manufacturers are carefully scrutinized, and whenever such guarantees are not lived up to, or whenever a guarantee is stated in such terms as to confuse the purchaser, the manufacturer is called upon to correct his copy and state his guarantee in unmistakable terms. Dealers wrongly naming or substituting batteries and parts have been detected in numerous cities and compelled to describe carefully the material they handle.

The sale of batteries is more directly influenced by advertising than that of any other electrical or automotive item. Therefore the restoration and maintenance of public confidence in the truthfulness of battery advertising is highly desirable. A great deal has been done to clarify the situation, but the field is very large and constantly increasing, so that the co-operation of every legitimate battery manufacturer, dealer, distributor and advertiser is necessary to establish and maintain "truth in advertising" in the storage-battery field.

Business Conditions

A Survey of Important Developments in the Electrical Market Including Data on Production, the Sales Outlook, Credits, Exports, the Metals and Other Conditions Affecting Cost, Supply and Demand

THE electrical business has continued to mark time this week and, if anything, has slowed down, with all eyes centering on the Democratic National Convention. The coming of the hot weather has brought life to the fan business, and fans are moving in considerable volume. There has been no spectacular movement in any other line, but well-diversified sales have been general to meet the current demand from a market in which shelves are empty. Conditions in New York are probably best right now, partly as a result of a considerable volume of building construction. San Francisco, Chicago and Texas have also reported better conditions than seem to be general. Little business is coming from the big industrials or railroads except for maintenance purposes. One of the large Middle Western central stations, however, has reported an increase in industrial power consumption.

Business has been spotty this week in New England. There have been some good sales of transmission line and switching equipment, and retail trade has shown improvement. In New York the aggregate of small orders has been good and there have been many inquiries of large proportions. Industrial buying for maintenance is better, but sales to contractors are off. Warm weather is helping markets in the Southeast and fan and range sales have been good. In the Middle West some of the utilities have been slowing up on their construction programs, but jobbers report business somewhat improved. On the Pacific Coast good orders for pole-line hardware and insulators are reported from northern California and railroad buying has improved after two quiet months. Sales to utilities are poor, however, and the dealers are inactive. Electrical contractors are doing a fair business.

Labor Conditions and Imports Affecting Mica Industry

THE North Carolina mica industry is said to need a higher tariff to protect it from the inroads of the British producers in India. North Carolina produces more than half the mica mined in this country, but the output is dwindling, chiefly because the producers cannot get labor at the price they are able to pay. Foreign competition is keeping the price of the product down, and consequently wages. The industry in North Carolina is being gradually strangled, according to H. T. Collins of the Electric Insulation Company of New York, and it is feared will eventually be completely destroyed unless it obtains a greater degree of protection from foreign competition. Mr. Collins has just returned from a trip to India, where he has been studying conditions.

May Delinquent Electrical Accounts Climbing

FOUR of the five divisions reporting to the central division of the Electrical Credit Association showed a greater number of accounts reported delinquent for May, 1924, than for May, 1923. During this same period, however, the average amount was lower for all the five sections reporting. Three of the divisions reported a larger number of accounts for May than for April, 1924. The complete list of delinquent accounts is contained in the table.

DELINQUENT ACCOUNTS IN MAY

Branch and Month	Number of Accounts Reported	Total Amount	Average Amount
Central Division:			
April, 1923...	794	$111,130.28	$139.96
April, 1924...	871	110,326.49	135.04
May, 1923...	749	95,984.35	128.15
May, 1924...	957	110,184.35	115.13
New York:			
April, 1923...	422	63,771.00	151.00
April, 1924...	471	64,648.00	138.00
May, 1923...	437	68,228.00	156.00
May, 1924...	366	51,725.00	141.00
Philadelphia:			
April, 1923...	241	35,099.19	145.80
April, 1924...	221	25,313.95	114.54
May, 1923...	225	26,399.32	117.33
May, 1924...	327	32,961.99	100.80
New England:			
April, 1923...	44	7,979.04	181.34
April, 1924...	35	4,442.94	126.94
May, 1923...	29	3,464.08	119.45
May, 1924...	70	6,883.85	98.34
Pacific Coast:			
April, 1923...	39	8,444.75	216.53
April, 1924...	31	3,869.93	124.84
May, 1923...	20	2,910.69	145.70
May, 1924...	28	3,180.00	113.57

Another General Reduction of "Mazda" Lamp Prices

FOR the second time this year the General Electric Company has announced a further general reduction of the prices of "Mazda" lamps, averaging about 10 per cent. This will be in effect throughout the United States on July 1. It is the fifth time that the price of "Mazda" lamps has been lowered since April, 1922. The previous reductions included one made at the date just named of about 9 per cent, one in October of the same year of approximately 8 per cent, one in May, 1923, of 10 per cent, and one in February of this year of 12 per cent. It is said that this latest reduction alone means an additional saving to the public of more than seven million dollars per year, and that if the lamps purchased today had been purchased at 1914 prices, without these successive reductions, the public's lamp bill would be thirty million dollars a year greater.

It is, of course, impossible to say definitely what effect these prices have had on the actual development of lamp demand, but it is an economic law that the lowering of prices of a commodity tends to extend its market, and certainly the use of electric light has been steadily and rapidly increasing, particularly in that greatest of all markets—the home. In 1910 less than

HOW "MAZDA" LAMP PRICES HAVE FALLEN IN THIRTY MONTHS

Size of Lamp, Watts	Jan. 1, 1922	Oct. 1, 1922	May 1, 1923	Feb. 1, 1924	July 1, 1924
"Mazda B":					
10—50	$0.40	$0.35	$0.32	$0.30	$0.27
"Mazda C":					
50	0.60	0.55	0.50	0.45	0.40
75	0.70	0.60	0.55	0.50	0.45
100	1.00	0.75	0.70	0.60	0.55
150	1.40	1.00	0.90	0.75	0.70
200	1.90	1.30	1.15	1.00	0.95
300	2.80	1.90	1.75	1.60	1.50
500	4.15	2.75	2.50	2.35	2.25
1,000	6.70	4.50	4.25	4.00	4.00

one-quarter of all the sockets were in the homes; now more than half of the sockets are in the homes, and the total number is nearly fourteen times that of 1910. In 1910 only one family in ten used electricity, while to-day this has increased to an average of every other family.

Ten years ago the average wattage of the lamps in use was about 48; today it is almost 20 per cent higher. In addition to this, the mean candlepower of the average lamp throughout life, which in 1914 was about 26, is now more than 60. With decreasing prices there has not only been a widening of the market, but also an increase in the size of lamp used.

The accompanying table shows "Mazda" lamp prices at important points during the past few years.

Quiet Week in Metal Market—Prices Decline Slightly

METAL sales during the week are continuing below the current rate of production, and prices have accordingly weakened slightly with no decline of importance. Foreign buying has been good. On Thursday of last week copper was freely offered at 12¼ cents, delivered, by nearly all producers, with some not anxious to book business beyond October. Some good business was offered at 12⅜ cents at that time, but only one small lot was reported sold. On Wednesday the metal was easily obtainable at 12⅜ cents. Copper is now selling at the lowest price since September 27, 1921.

NEW YORK METAL MARKET PRICES

	June 18, 1924 Cents per Pound	June 25, 1924 Cents per Pound
Copper, electrolytic	12¼–12⅜	12⅜
Lead, Am. S. & R. price	7.00	7.00
Antimony	8¼–8½	8¼–8½
Nickel, ingot	27	27
Zinc, spot	6.10–6.15	6.10
Tin, straits	43⅜	43¼
Aluminum, 98 to 99 per cent	28	28

There has been little demand for lead, which can be obtained at 7 cents from practically every producer and for forward delivery. A slight amount has been sold at 6.975 cents, but there is little enthusiasm on the part of potential buyers.

There has been no pressure to sell zinc at present prices, although the demand has been light. Foreign sales have been very satisfactory.

Tin prices are holding up, but there has been no demand, nor do dealers show any desire to sell.

Little Large Business in New York District—Volume Good

THERE is very little large business being transacted in the New York district, and sales continue to be made up of a number of small orders, which, however, in the aggregate are not much below those of last year. Inquiries continue to enter the market and many large projects are known to be under contemplation, but there is still an apparent hesitation as to making commitments on any of them. The general feeling among electrical men is that the present state of trade is due almost entirely to the political situation and that orders will materialize from present inquiries early in the fall.

The warm weather early this week has brought about a strong demand for fans, and manufacturers' stocks are being heavily drawn upon by jobbers, but so far they are still able to make prompt deliveries. Contractor-dealer business has fallen off somewhat and in the aggregate is from 10 per cent to 20 per cent below last year's business. Some sections are as much as 40 per cent and 50 per cent off, while other sections have shown an improvement. Maintenance orders by industrials are reported as being good, taken as a whole. Electric flatirons are in very good demand. Radio business is fair and is about twice as large as that transacted during the same period last year.

Business Spotty in New England—Retail Trade Improved

GENERAL business in New England is spotty. Last week's building contracts totaled $5,578,000, compared with $4,609,000 a year ago. Prices in the electrical field are fairly quiet, except for a weakness in weatherproof wire quotations and a reduction of about 5 per cent in pole-line hardware. The progress of interconnection continues to result in the sale of a substantial amount of transmission line and switching equipment.

A turn for the better was apparent this week. Warm weather stimulated retail business and dealers with low stocks turned to the jobbers in response to the increasing demand for appliances, fan sales making an active spurt. Range and refrigerating plant sales are healthy, and a movement toward better organization of domestic cooling-installation business will shortly bear fruit. Hollow ware for bridal gifts is moving well and washers and flatirons are selling actively. One large central station which recently faced a decided falling off in new business reports an improvement and will probably not be obliged to curtail any of its activities.

Weather Conditions Brighten Outlook in Southeast

A TEN-DAY period of very hot weather throughout the Southeast has served to improve argicultural prospects, and while no change in general business conditions is reported, the outlook is brighter than for some weeks past. Building contracts awarded during the month of May amounted to $60,719,100, this being an increase of approximately $7,000,000 over April contracts. The Southern Railway has recently let a contract for the construction of new shops at Spartanburg, S. C. This shop will be electrified and 1,500 men employed when it is completed.

Electric range sales are reported good throughout the district, one central station selling 371 ranges among eight thousand customers in a period of six weeks. Fan business has been very good and jobbers are placing telegraphic orders for additional stocks. Campaigns by a number of central stations have boosted electric iron sales to a very satisfactory volume. In rural districts the demand for auto starting and lighting batteries, sales of which reached a low ebb thirty days ago, is the highest since the first of the year.

Collections are somewhat slower than last month, and there is an indication of credits being a little tighter during the next ninety days.

Business Continues Good in the Middle West

BUSINESS conditions remain virtually the same this week in the Middle Western district. While it is believed that the volume has increased, the week has been quiet and optimism is prevalent. Central-station construction continues and additional contracts for smaller substations are being placed, but maintenance purchasing appears to be the principal factor with the utilities. Owing to changes in construction programs, some of the larger utilities are requesting that shipments of major apparatus be deferred. This is felt to be only a temporary arrangement and should rectify itself within a short time. Stocks are being maintained at the lowest possible level, and purchases are still being limited to thirty days' requirements.

The jobbing trade reports having had a rather good week, and some good orders for wiring material were received. Prices remain stable, with the exception of armored cable, which dropped $2 per 1,000 ft. this week. Building permits taken out this week fell below last year's mark, but there is apparently no recession in building activities. Appliance sales have held up well for the month so far, and it is anticipated that they will continue good for the remainder of the month.

Fair Trade on Pacific Coast—Quiet in Sections

DEALER business is rather quiet on the Pacific Coast, while that of the electrical contractors is fair despite the customary lull in buying during the latter part of the month. Purchasing by utility companies has improved in northern California, where some good pole-line hardware and insulator orders are reported, but it is very poor in southern California. Sales of construction tools and guy anchors have been rather disappointing, but it is generally conceded that the market is inactive as a rule at this time of the year for such lines, and it is further felt that much construction will be postponed until next year. Railroad business is again very good after a couple of quiet months. It includes such items as 400 miles of copper wire and 10,000 glass insulators.

Rubber-covered wire sales are good and the prices are much firmer. Very good sales are also reported on electric flatirons, especially of the smaller sizes for travelers' use, and radiator business is now being solicited for fall delivery. Many orders for intercommunicating telephones are reported. Through excellent aggressive sales work carried on in industrial plants, a very good renewable-fuse business is developing, although the standard non-renewable indicating style still supplies the bulk of the business.

Activities of the Trade

Devoted to News of the
Manufacturer, Jobber, Agent, Contractor and Dealer, Including Important Orders and Contracts for Apparatus and Equipment

Western Electric Reports Record Sales

Larger business than that of any period during the fifty-five years' experience of the Western Electric Company was transacted during the first five months of 1924. Sales totaled $122,280,000, as against $93,478,406 for the 1923 period. This large increase in business represents consistent effort to keep the manufacture of telephone and telegraph apparatus in pace with the continued growth of the Bell System and the demand for telephone service.

Orders received by the company during the first five months of the year were the largest on record, amounting to $136,283,000. On May 31 the orders on hand amounted to $108,954,000, greater by $20,673,000 than for the same time a year ago.

Westinghouse Receives Generator Order from California

The Westinghouse Electric & Manufacturing Company has received an order from the Southern California Edison Company for a 28,000-kva., 89.3 per cent power factor, three-phase horizontal waterwheel generator which will be installed in the Edison company's Big Creek No. 1 station. The machine is so designed that at a speed of 300 r.p.m. it delivers current at 11,000 volts, 50 cycles, and at a speed of 360 r.p.m. current is delivered at 12,000 volts, 60 cycles. The generator is complete with a direct-connected exciter.

Railway & Industrial Engineering Completing Factory Building

The Railway & Industrial Engineering Company of Greensburg, Pa., manufacturer of transmission, switching and protective equipment, is rapidly completing a factory building of brick and steel construction which, when finished, will virtually double the present available manufacturing floor space. The construction program also provides for approximately 7,500 sq.ft. of inclosed floor space for storage purposes.

The new building will be devoted almost exclusively to the fabrication of outdoor steel substations, and the new equipment which has been ordered will increase the output to more than 300 tons of steel per month. The increase in the volume of steel substation orders received during the last six months has necessitated this expansion. A 15-ton electric traveling crane will handle both raw and finished material direct to and from the company's railroad siding.

The design and detailing of the building as well as the fabrication and erection of the steel work are being handled entirely by men in the company's organization. The steel is being fabricated in the present steel shop, which is the site of the new building. The old building will later be torn down.

Electric Storage Battery Building Warehouse at Chicago

The Electric Storage Battery Company has acquired a tract of land of about 3 acres on Western Avenue near Forty-seventh Street, Chicago. The first unit, which will cover the southern half of the property, will be built at once. This will be a two-story-front and one-story-rear building, extending to the railroad, which will contain about 75,000 sq.ft. of floor space. The northern half of the plant will be built as increasing business warrants.

This building will serve as the company's Chicago factory branch, depot and service station, an activity now centered in its building at Thirty-fifth Street and Shields Avenue, which has been occupied for fifteen years. The factory staff and some of the executive departments will be moved to the second-story offices of the new building. The sales department of the company will remain in the Marquette Building.

Western Electric Opens Branch at Davenport

The Western Electric Company has added to its national chain of distributing houses by opening a branch at 121 East Fourth Street, Davenport, Iowa, to serve the industry better by providing a more localized service with complete stocks close at hand and consequently better deliveries. The Davenport branch, like other branches, will be fully equipped with stocks of wiring supplies, motors and control, lighting fixtures, line materials, lamps, power and light plants, etc. The new branch will have a floor area of 16,000 sq.ft. E. L. Johnson has been appointed manager and D. O. Manix stores manager.

The Combustion Engineering Corporation, New York, and the **Babcock & Wilcox Company,** New York, have received orders from the Narragansett Electric Lighting Company, Providence, for pulverized-fuel equipment and four boilers aggregating 7,100 hp. to operate at 375-lb. steam pressure. The Narragansett company has previously received fuel oil almost exclusively. Jenks & Ballou of Providence are the consulting engineers. The pulverized-fuel equipment contract was placed through Schumaker Santry Company, Boston.

Central-Station Women Study Lighting

Fifty Saleswomen of Power Companies and Dealers Take the Edison Lamp Course at Harrison, N. J.

A GROUP of fifty saleswomen of the eastern section of the country, representing central-station companies and a few dealers, spent last week in Harrison, N. J., as guests of the Edison Lamp Works for a course of study in home lighting. These were all women vitally interested in the selling of lighting units and electrical appliances to the housewives of their respective communities. A series of talks on lighting were given by various members of the Edison Lamp Works, and the visitors were shown the various operations in the manufacture of the "Mazda" lamp. A tour through various fixture display rooms of New York City was also arranged.

The Miller Company of Meriden, Conn., also invited the group to visit the Miller factory. A special dining car and two Pullmans were provided for their use, and lunch and dinner were served en route to Meriden. On Friday afternoon a round-table discussion was held, each member of the conference giving a short talk on her work and asking any questions not hitherto answered by the various speakers. Prizes were awarded for the best lighting arrangement suggested on a blueprint layout.

SALESWOMEN OF CENTRAL STATIONS AND ELECTRICAL DEALERS GATHERED AT EDISON LAMP WORKS

The Truscon Steel Company, Youngstown, Ohio, has organized a pole department, with Frederick Maples in charge, to take care of the manufacture of its new steel poles. Mr. Maples was formerly power director of the Long Island section of the Pennsylvania Railroad and more recently sales engineer with Hubbard & Company, Pittsburgh.

The Acme Electric Heating Company, Inc., Boston, manufacturer of industrial and domestic heating devices, has appointed C. L. Hight as sales representative of the New York district. Mr. Hight will have offices at 227 Fulton Street, New York.

The Rome Wire Company announces the opening of a sales office with a complete warehouse stock of its products at the Ninth Street terminal warehouse, 1200 West Ninth Street, Cleveland. C. R. Evans, district manager, will be in charge.

The Sanford Riley Stoker Company, Worcester, Mass., has appointed C. O. Hoban, formerly of the sales staff of the Philadelphia office, as representative for western Pennsylvania and West Virginia. Mr. Hoban will have his headquarters at 1216 Farmers Bank Building, Pittsburgh.

Webster Tallmadge, engineering specialist, announces the removal of his offices from 50 Church Street to the new Westinghouse Building, 150 Broadway, New York.

The Gisholt Machine Company, Madison, Wis., manufacturer of electric clocks, grinders, etc., announces the purchase of the business and entire line of machines of the Millholland Machine Company of Indianapolis, Ind.

The International General Electric Company and the **Allis-Chalmers Manufacturing Company** have been awarded contracts for electrical and mining equipment for the El Potosi mines of the Howe Sound Company at Chihuahua, Mexico, totaling $600,000, of which the International Company's share is $500,000.

The Roller-Smith Company, 233 Broadway, New York, is now providing its type GSA single-phase and polyphase wattmeters with two current capacities, so as to enable one instrument to cover a wider range. The company is also prepared to furnish quotations on and supply reactive-factor and reactive-kilovolt-ampere meters.

The Howell Electric Motors Company, Howell, Mich., has appointed the Bryan Electric Company, Atlanta, as distributor for Georgia. The Stevens-Goin Electric Company, Jacksonville, Fla., has been appointed distributor for Florida.

The Hugro Manufacturing Company, Warsaw, Ind., manufacturer of vacuum cleaners, etc., recently adjudged bankrupt, is to be sold at public auction by order of the court on July 17, 1924. The S. L. Wintternitz Company, First National Bank Building, Chicago, is in charge of the sale.

The General Electric Company has recently opened a service shop in Kansas City, provided with machine equipment of new and up-to-date design. A further development in General Electric repair service is the establishment of repair sections in the various factories at Schenectady, Lynn, Erie, Oakland (Cal.) and Fort Wayne. In addition to the service shop at Kansas City, service shops have been established within a year in Los Angeles, Seattle and Dallas.

The Beaver Machine & Tool Company, Inc., Newark, N. J., manufacturer of electrical specialties, announces the appointment of the following district sales representatives: Robinson & Bell, 2362 University Avenue, St. Paul; Electric Sales Company, Kenyon Building, Louisville; Louis L. Barnes, Station E, Atlanta; Henger-Fairfield, 420 Engineers' Building, Cleveland, and L. R. Pierson, Benbow Arcade, Greensboro, N. C. These representatives are appointed to take care of the expansion of the firm.

The F. W. Wakefield Brass Company, Vermilion, Ohio, announces that the Ohio Public Service Company in a recent campaign sold 2,609 "Red Spot" store-lighting units in ten days to a total of only 6,370 buyers. This lighting unit is especially designed for central-station campaign sales.

The Western Electric Company has appointed Max Morris in charge of sales in the Atlanta branch. Mr. Morris was formerly supply specialist in this office and is succeeded by John Hamilton from the New Orleans office.

New Equipment Available

Short Descriptions of New Apparatus and Accessory Equipment of Interest to the Electrical Industry and Available from Manufacturers and Announcements of New Lines

Truck-Type Oil Switch

Truck-type oil-switch units mechanically interlocked for electrical remote control and using one trip coil are now being marketed by the Condit Electrical Manufacturing Company, South Boston, Mass. They are available in sizes of 1,200 amp. or less, 12,000 volts, and 1,600 amp., 7,500 volts, at 60 cycles. These units are designed to occupy minimum space with relatively high interrupting capacity.

Each tank is substantially supported by a heavily ribbed cradle and reinforced at the top by a deep extending flange on the frame. They are suitably lined and arranged to take an oil gage. Inverted brushes and a laminated bridging member constructed of hard-drawn copper laminæ are used. The current-carrying members are protected by renewable stationary and movable arcing tips.

Measuring Instruments

A double-range self-contained ammeter, known as the type GSA, has been developed by the Roller-Smith Company, New York. In this meter the ranges overlap, which makes it possible to cover a very wide range with a single instrument.

The company has also placed on the market the type GSA combination volt-ammeter for general alternating-current testing work. This instrument can be obtained with two or three voltage ranges if desired.

Definite Time Relay

A new type of alternating-current definite time relay known as the MC-9, especially applicable to automatic starters for alternating-current motors to give a definite time interval between the closing of the contactors used in accelerating the motor, has been placed on the market by the General Electric Company. In addition to being used for accelerating synchronous-motor starters, it automatically energizes the field circuit after the motor is up to full speed. The device consists of a diminutive constant-speed bi-polar induction motor operating a tripping mechanism through a gear train. The time-delay adjustment is obtained by moving an index over a calibrated scale on the face of the relay. Time delays of from one-half second to thirty-three seconds on 60 cycles and to 123 seconds on 25 cycles may be obtained.

The relay is designed for wall or panel mounting and is inclosed in a dust-tight sheet-metal case with the leads brought out at the top of the case. The dimensions of the complete unit are 8 in. x 6 in. x 5¼ in. and the weight is approximately 12 lb.

Lightning Arrester

A "pellet" type of lightning arrester, which is a modification of the cell type of oxide-film arrester and is designed for use on voltages from 300 to 15,000, has been placed on the market by the General Electric Company.

In this pellet arrester, lead peroxide is formed into small pills or pellets about $\frac{3}{32}$ in. in diameter. These are coated with lithage powder, forming a film similar to the varnish film on the cell type of arrester. The pellet is thus a miniature cell, consisting of an oxide film and an active internal filler. These litharge-coated pellets are placed in a porcelain tube and assembled in good electrical contact with metal electrodes at each end of the column. Between the line lead and the pellet column is a small series gap assembly which isolates the pellets from continuous application of dynamic voltage but which allows discharge to take place at a definite voltage above normal. After a discharge the oxide film "reseals," preventing the dynamic current from following the abnormal surge.

Electric Bench Grinder. — A two-wheel 6-in. electric bench grinder equipped with a thermostatic safety motor switch and Hisey full safety combination wheel guards has been placed on the market by the Hisey-Wolf Machine Company, Cincinnati.

New Trade Literature

TELEPHONE AND RADIO SUPPLIES.—The Belden Manufacturing Company, Twenty-third and Western Avenue, Chicago, has issued bulletin No. 1,945, covering its cord and specialties department. It contains sectional tables of contents which show radio material, telephone material and motor repair material. The index is also cross-referenced with the corresponding pages of the company's general catalog No. 9.

BRASS AND ITS USES.—The Chase Metal Works, Waterbury, Conn., has issued a booklet entitled "How to Order Brass," which contains information regarding the composition of brass and its many uses and characteristics and how to make specifications definite when ordering the metal. Six pages are devoted to tables on "Common Uses and Tempers of Wrought-Copper Alloys."

INDUCTION MOTORS.—The Marble-Card Electric Company, Gladstone, Mich., is distributing bulletin No. 300, covering its alternating-current polyphase induction motors.

SYNCHRONOUS MOTORS.—Bulletin No. 833 issued by the Electric Machinery Manufacturing Company, Minneapolis, describes its "E-M" junior synchronous motors for direct connection for small air compressors.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number:

Purchase is desired in Batavia, Java (No. 10,671), for electrical supplies, including instrument transformers, switchboards, oil switches, instruments, high-voltage insulators, 75-kva. transformers, etc.; also boilers and engines with complete equipment.

Purchase and agency are desired in Vienna, Austria (No. 10,703), for tailors' electric irons and for transformers for electric bells and stoves.

An agency is desired in Bombay, India (No. 10,679), for electric motors.

Purchase is desired in Mexico City, Mexico (No. 10,710), for street lamps, candelabrum style.

An agency is desired in Lille, France (No. 10,681), for centrifugal and plunger piston pumps for feeding generators.

ELECTRICAL MATERIAL FOR BUENOS AIRES, ARGENTINA.—Tenders will be received by the Department of Navigation and Ports, Buenos Aires, Argentina, until Aug. 25 for electrical material, including insulators and insulating material, wires and cables, electric lamps and holders, telephone bells, mouthpieces and cords, dry cells, etc.

ELECTRIC METERS FOR SYDNEY, AUSTRALIA.—The Municipal Council of Sydney Australia, will receive tenders until July 28 for alternating-current and direct-current service meters.

AUTOMATIC TELEPHONE SYSTEM PROPOSED FOR SOUTH AFRICA.—Tenders will be received by the Egyptian State Railways, Telegraphs and Telephones Commission, Cairo, Egypt, until October 30 for automatic telephone equipment and substation (subscribers' apparatus) at Cairo.

ELECTRIC METERS FOR CAPE TOWN, SOUTH AFRICA.—Tenders will be received by the Municipal Council of Cape Town, South Africa, until July 7 for 1,000 alternating-current electric meters, house-service type.

AUTOMATIC TELEPHONE SYSTEM PROPOSED FOR UNION OF SOUTH AFRICA.—Tenders will be received by the High Commissioner of the Union of South Africa, Cape Town, until July 31 for automatic telephone exchanges for Parktown, Mayfair, Hatfield and Kloof. Copies of tender forms, with specification and drawings, may be obtained at the office of the High Commissioner, Union of South Africa, Trafalgar Square, W. C. 2, London, England.

ELECTRICAL MATERIAL FOR MONTEVIDEO, URUGUAY.—Tenders will be received by the State Electricity Works, Montevideo, until July 8 for six three-phase, 6,000/220-volt transformers, low-tension switchboard and accessories; until July 9 for copper wire and cable, and until July 24 for 82,000 meters of wire and cable.

BIDS DESIRED FOR AN ELECTRIC PLANT IN MEXICO.—Bids are being asked by a concern in Mexico, *Commerce Reports* states, for the installation of an electric light and power plant. The equipment required includes two oil engines of 200 hp., two 170-kw. generators and one 10-ton crane. Further information may be obtained from the Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C., or its district offices by referring to No. 133,594.

New Incorporations

THE OLDSMAR (FLA.) LIGHT & POWER COMPANY has been incorporated with a capital stock of $20,000. The officers are C. C. Schapier, president, and R. L. Smith, secretary.

THE COMAL POWER COMPANY, San Antonio, Tex., has been incorporated with a capital stock of $1,000 for the purpose of acquiring a site on the Guadalupe River near New Braunfels for a hydro-electric plant. W. B. Tuttle is president and E. H. Kifeo is general manager, both of San Antonio.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

PORTSMOUTH, N. H.—Bids will be received by the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until July 1, for six electrically heated cooking kettles and spare units and three electric ranges and spare parts (Schedule 2332).

BOSTON, MASS.—The Edison Electric Illuminating Company plans to build an equipment storage and distributing plant, to cost about $45,000.

FORE RIVER, MASS.—Bids will be received by the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until July 1, for two motor-generator sets and spare parts (Schedule 2328).

NORTON, MASS.—Plans have been prepared for the construction of a power house at Wheaton College, to cost about $80,000. Cram & Ferguson, 248 Boylston Street, Boston, are architects.

WORCESTER, MASS.—The petition of the New England Power Company to erect its electric lines into the South Works of the American Steel & Wire Works, Kane Square, has been approved by the State Department of Public Utilities.

Middle Atlantic States

ALTMAR, N. Y.—The Niagara, Lockport & Ontario Power Company, Buffalo, contemplates the construction of a transformer station in Altmar, to cost about $600,000.

BALDWINSVILLE, N. Y.—The Seneca River Power Company has been granted permission to extend its transmission lines into Clay to furnish electricity in part of the town. The company will extend its distribution lines through Three Mile Point, Meyers Corners and Belgium.

BROOKLYN, N. Y.—Bids will be received by the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until July 8, for eight electric air heaters for the Brooklyn and Mare Island navy yards (Schedule 2350).

COLCHESTER, N. Y.—The Cook Falls (N. Y.) Electric Company has been granted permission to construct an electric plant in the town of Colchester to supply electricity for light and power in Beaver Valley, Cooks Falls and Horton. Colchester has not a post office.

DE PEYSTER, N. Y.—The St. Lawrence County Utilities, Inc., has been granted permission to extend its lines in the town of De Peyster and to exercise a franchise granted by the town officials.

EAST WORCESTER, N. Y.—The Public Service Commission has authorized the transfer of the property of the Great Bear Light & Power Company to the Fulton Gas & Electric Company, Gloversville. Distribution lines will be rebuilt in the villages of Schenevus and East Worcester and power service will be furnished in this territory. A twenty-four-hour service is promised.

POUGHKEEPSIE, N. Y.—The East End Board of Trade has requested the Board of Aldermen to extend the ornamental lighting system on Main Street to the city line.

WATERTOWN, N. Y.—The Northern New York Utilities, Inc., has applied to the Public Service Commission for authority to build a hydro-electric plant at the Soft Maple Dam on the Beaver River and at Sewall's Island on the Black River. The Soft Maple project includes the construction of a diversion dam about 65 ft. high and a terminal dam 160 ft. high, and a power house equipped with two 10,000-hp. turbines. Provision will be made for futrue extension to power station to house an additional 10,000-hp. unit. The cost is estimated at $2,370,000. The Sewall's Island plant will develop about 2,500 hp. and will cost about $340,000.

DOVER, N. J.—The New Jersey Power & Light Company is planning to extend its transmission lines from Pittstown to Baptistown and Frenchtown.

TRENTON, N. J.—The Public Service Electric Company has been granted a franchise to erect a transmission line on Carter Road, Mercer County; also to build a short line on Rosedale Road.

ALLENTOWN, PA.—Officials of the Pennsylvania Power & Light Company are organizing a number of subsidiary companies to erect transmission lines in the respective territories for which they are named, including the Sugar loaf, Pine, Orange, Fishing Creek and Benton-Columbia Light & Power companies. P. B. Sawyer and C. M. Walter are interested in the companies.

BEAVER FALLS, PA.—The Duquesne Power & Light Company has petitioned the City Council for approval of the proposed route for the new transmission lines to the Keystone Driller factory.

DELTA, PA.—The Lower Chanceford Electric Light, Heat & Power Company contemplates extending its transmission line 4 miles. R. D. Snyder is secretary.

ERIE, PA.—The Erie County Electric Company is making extensions and improvements to its system, including the construction of a substation and warehouse, for which contract has been awarded; the erection of a 13,800-volt transmission line to substation; a dual exciter set, skip hoist and coal-storage facilities. P. G. Sturtevant is engineer.

WASHINGTON, D. C.—Bids will be received by the Purchase and Issue Subdivision, United States Veterans' Bureau, Arlington Building, until July 1, for one electric range (Circular G-110).

WASHINGTON, D. C.—Bids will soon be asked by the Superintendent of State, War and Navy Buildings, 1034 Navy Building, for power-plant equipment, for which specifications are being prepared.

WASHINGTON, D. C.—Bids will be received by the general purchasing officer, the Panama Canal, Washington, D. C., until July 21 for Diesel engine-driven generator equipment for stand-by generator stations. For details see Searchlight Section.

North Central States

BATTLE CREEK, MICH.—The Grand Trunk Railway Company contemplates the construction of a power station at its proposed local engine terminal and shops, to cost about $600,000.

LANSING, MICH.—The City Council has approved an appropriation of $50,000 for extensions in the present boulevard lighting system, covering fourteen city blocks.

MUSKEGON, MICH.—The City Council is planning for improvements to the street-lighting system, including replacing a number of 100-cp. units with 600-cp. lamps.

EAST AKRON, OHIO.—The Trump Rubber Company contemplates building a power house at its plant, to cost about $25,000.

AMELIA, OHIO.—The village officials are considering changing the system of the municipal electric light plant from 220/240 volts to 2,200/110/220 volts. Nothing will

be done at present. J. H. Theisz is superintendent.

KENTON, OHIO. — The Ohio Power Company, Canton, has been granted a franchise to extend its high-tension lines into the city of Kenton to furnish electricity here. The company proposes to extend its 66,000-volt line from Upper Sandusky to Forest and then on to Kenton. Eventually it is planned to connect Kenton with the proposed line to be erected between its new power plant at Philo and Lima.

LONDON, OHIO.—Improvements contemplated by the London Light & Power Company this year include revamping the local distribution system, removing lines from streets to alleys, putting in all new transformers and wire with increased capacity. O. W. Bridgemen is vice-president and manager.

MINSTER, OHIO.—Plans are being considered to rebuild the entire municipal electric light plant. It is proposed to change the system from 220 volts, direct current, and 440 volts, alternating current, to 110/220 volts, 60 cycles, alternating current. M. W. Utz is superintendent.

SHELBY, OHIO.—Extensions are being made to the municipal electric light plant, including the installation of a 1,000-kw. General Electric generator connected to a Curtis steam turbine. A. Dornberger is superintendent.

FALMOUTH, KY.—The Kentucky Northern Power Company has been granted a preliminary permit for a power project on the Licking River, near Falmouth.

DECATUR, IND.—The Farmers' Light & Power Company expects to install some new transformers this year. C. D. Spuller is secretary and manager.

INDIANAPOLIS, IND.—Plans for the proposed new plant of the Cornelius Printing Company, 235 North Capitol Avenue, include a power house. The cost of the entire project is estimated at $170,000. The Russell N. Edwards Company, Union Trust Building, is architect.

MOORESVILLE, IND.—Bids, it is understood, will soon be asked by the board of education for a power plant for school service. W. H. Garns, Fletcher Trust Building, Indianapolis, is engineer.

MARINETTE, WIS.—The Marinette & Menominee Paper Company has applied to the Railroad Commission for permission to rebuild its power dam on the Menominee River with a view to increasing the electrical output of its plant.

RHINELANDER, WIS.—The City Council has authorized the installation of an ornamental lighting system in Stevens Street from Anderson to River Street.

OWATONNA, MINN.—Bids will be received by the Utilities Commission until July 8 for the construction of a 1,000-kw. steam-driven electric plant, complete with electric distribution system and street-lighting system and steam-heating system in the business district. Plans and specifications can be secured from Arthur L. Mullergren, Gates Building, Kansas City, Mo., consulting engineer. Bonds to the amount of $350,000 have been voted for this work. M. R. Cashman is chairman of commission.

BELLEVUE, IOWA. — Electric power equipment will be installed in connection with the proposed rebuilding of the plant of the Johnson Piano Company, recently damaged by fire with loss of about $200,000.

BOONE, IOWA.—The Iowa Railway & Light Company contemplates erecting a high-tension transmission line from Boone to Grand Junction, where it will connect with a line from Perry. The cost is estimated at $50,000.

CLARINDA, IOWA.—The Lee Electric Company will erect a new substation here to be equipped with 2,225 kva. transformers.

MONDAMIN, IOWA.—The Iowa Service Company will erect a 6,600-volt transmission line, 15 miles long, from Mondamin to serve Little Sioux and Pisgah.

STANTON, IOWA.—The Iowa Service Company will build a new distribution and street-lighting system in Stanton this summer.

BURLINGTON JUNCTION, MO. — The Maryville Electric Light & Power Company will build a substation in Burlington Junction to serve this and several neighboring towns.

MARYVILLE, MO.—The Maryville Electric Light & Power Company will erect a new substation equipped with 1,000 kva. in transformers.

WILLOW SPRINGS, MO.—Bids, it is reported, will soon be asked for rebuilding the municipal electric light and power plant, recently destroyed by fire. The Alexander Engineering Company, Woodruff Building, Springfield, Mo., is consulting engineer.

WEBSTER, S. D.—The Council is negotiating for the sale of the municipal electric power plant and contemplates the erection of a transmission line to Summit to secure local service.

BLAIR, NEB. — A contract recently awarded for equipment for the municipal power plant has been rescinded. Improvements and repairs will be made in the present machinery for the time being, and bids asked in the future for other apparatus. The Prince-Nixon Engineering Company, Peters Trust Building, Omaha, is engineer.

HASTINGS, NEB. — The Council has abandoned plans for the time being for the proposed new municipal and waterworks station, to cost $50,000. Bids received have been rejected.

RIVERDALE, NEB.—Bonds have been authorized by the voters to build a transmission line from Kearney to Riverdale to supply electricity for street-lighting and commercial purposes.

ABILENE, KAN.—The United Power & Light Corporation, it is reported, will soon ask for bids for the erection of a transmission line from Abilene to Junction City (25 miles), to cost $40,000; 25-mile line from Abilene to Salina, $50,000; 53-mile line from Salina to Inman, $107,000; 37-mile line from Hays to Russell, and branch lines, $40,000, each 33,000 volts; substations and tap lines, $80,000; Victoria, Walker and Gorham distribution systems, $25,000; improvements to the Hays plant, $150,000 to $300,000. Y. Y. Young, Abilene, is engineer.

HAYS, KAN. — The United Power & Light Corporation, which has acquired the municipal electric system, plans extensions and improvements to the local plant, including additional equipment, to cost $200,000.

IOLA, KAN.—The installation of a 1,500-kw. turbo-generator unit in the municipal electric plant is under consideration. A 500-hp. Heine boiler is now being installed. A. D. Morris is utility commissioner.

Southern States

CLAREMONT, N. C. — Bonds to the amount of $10,000 have been issued, the proceeds to be used for the installation of an electric light and power system.

JACKSONVILLE, N. C.—Bonds to the amount of $12,000, have been issued, part of the proceeds to be used for the installation of an electric light and power system.

TROY, N. C.—The Carolina Power Company has leased the transmission system of the Smitherman Power Company. Extensions are planned to connect with the system of the Carolina company.

WHITEVILLE, N. C.—The Tidewater Power Company, Wilmington, has acquired the municipal electric plant and plans to extend its transmission line here. From Whiteville the line will be extended to Causey, Nichols and Mullins, where it will supply electrical service.

SUMMERTON, S. C. — Bonds to the amount of $12,000, has been issued, the proceeds to be used for extensions and improvements in the municipal electric plant.

SAVANNAH, GA.—Bids will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until July 9 for an ice-making and refrigerating plant at the United States Marine Hospital, Savannah.

CHATTANOOGA, TENN.—The Tennessee Electric Power Company plans to erect a 44,000-volt transmission line to North Chattanooga, and to install an outdoor substation.

COLUMBIA, TENN. — The Southern Cities Power Company has awarded a general contract for the construction of a dam and power house on the Columbia River, to cost about $125,000. Equipment contracts will be let in the near future. Freeland, Roberts & Company, Nashville, are consulting engineers.

COOKEVILLE, TENN.—Bids will be received by J. E. Ownes, city clerk, until June 27 for improvements to waterworks system, including centrifugal pumps, pump houses, 5 miles of transmission line, etc., to cost about $150,000. V. V. Long & Company, Colcord Building, Oklahoma City, Okla., are engineers.

LAWRENCEBURG, TENN.—Bonds to the amount of $25,000, have been issued, part of the proceeds to be used for extensions in the municipal electric plant and system.

JACKSON, MISS.—The board of trustees of the penitentiary has awarded a contract for the installation of a complete electric lighting system to Orgill Brothers & Company, Memphis, to cost about $43,000.

AMITE, LA.—The Central Light & Power Company plans to install a 1,000-kw. turbo-generator at its plant with accessory equipment.

CLINTON, OKLA.—The Oklahoma Gas & Electric Company, which recently acquired the municipal electric plant, plans to make extensions and improvements to same.

HOBART, OKLA.—The Inland Utilities Company, Kansas City, Mo., has been granted a local franchise and is reported to be planning to install an electric power plant, using oil-engine-driven generators.

BROWNWOOD, TEX.—The local Chamber of Commerce is said to be interested in a proposed hydro-electric development in connection with an irrigation project for reclaiming approximately 30,000 acres of land. The cost of the project is estimated at $2,000,000.

CRAWFORD, TEX.—The City Council is considering the installation of a municipal electric plant and waterworks system.

DALLAS, TEX.—Arrangements are being made by the Dallas Power & Light Company for the installation of a generator, to cost about $41,000, in the plant being erected in North Dallas.

FORT WORTH, TEX.—A power house will be built at the proposed local cotton mill to be erected by a new company, headed by Charles L. Harding, president of the Whitman Mills, and Charles M. Holmes, treasurer of the Page Manufacturing Company, both of New Bedford, Mass. The plant will cost about $1,000,000. All machinery will be electrically operated. Charles T. Main, 200 Devonshire Street, Boston, is architect and engineer.

MIAMI, TEX.—The Council contemplates the rebuilding the municipal electric light and power plant, recently damaged by fire.

NEW BRAUNSFELD, TEX.—The Comal Power Company, recently organized by the officials of the San Antonio (Tex.) Public Service Company, plans to build a power plant near New Braunsfels.

Pacific and Mountain States

GRAND DALLES, WASH.—Application has been filed with the Supervisor of Hydraulics, Olympia, by Leo F. Brune, Grand Dalles, for a permit to divert the water of Spring, a tributary of Eight Mile Creek, for irrigation, power and domestic purposes.

KALAMA, WASH.—Plans are being considered by the Doty Fish Company for rebuilding its power house and cold-storage plant, recently destroyed by fire, causing a loss of about $100,000.

PORT ANGELES, WASH.—A petition has been presented to the City Commission asking for the installation of cluster lamps on Front Street and a portion of Laurel Street.

RIDGEFIELD, WASH.—The Ridgefield Light & Power Company has applied for a franchise to erect a number of transmission lines in the southern part of Clarke County.

SEDRO WOOLLEY, WASH.—The City Council contemplates the installation of an ornamental lighting system on portions of Woodworth and Murdock Streets.

TACOMA, WASH.—An ordinance has been passed by the City Council authorizing the installation of street lamps on McKinley Avenue and Division Lane to East Fortieth Street.

TROUT LAKE, WASH.—Application has been filed with the Supervisor of Hydraulic, Olympia, by J. M. Bruce, Trout Lake, for a permit to divert 350 second-feet of waters of White Salmon River for power purposes.

ALBANY, ORE.—The Mountain States Power Company plans to erect a transmission line from Beaver Hills Junction to Bandon.

PORTLAND, ORE.—The Columbia Valley Power Company, North West Bank Building, contemplates hydro-electric developments on the Deschutes River at Pelton, to including a dam 165 ft. high to develop 51,000 hp.; also at Metolius, later, including dam about 330 ft. high.

CHICO, CAL. — The Board of City Trustees has authorized plans for the installation of an ornamental lighting system on Main Street, Broadway and Oroville Avenue. Fluted steel standards will be used. C. M. Ennis is city engineer.

FRESNO, CAL.—The Pacific Gas & Electric Company has appropriated $300,000 for extensions and improvements to its lines in this section during the next year.

FULLERTON, CAL.—The City Council has directed W. C. Record, City Engineer, to make investigations as to the feasibility of building an electric generating plant which might be operated by natural gas and as to cost of same, and also to include in the report the probable prices at which energy might be purchased from the Southern California Edison Company.

GLENDALE, CAL.—The installation of an ornamental lighting system on Colorado Boulevard is under consideration by the property owners.

GRASS VALLEY, CAL.—The Nevada Irrigation District is securing estimates of cost for its proposed irrigation system and hydro-electric development at the Jackson watershed, upper Middle Yuba River. The cost is estimated at about $6,000,000. Fred H. Tibbetts, Alaska Commercial Building, San Francisco, is consulting engineer.

HUNTINGTON BEACH, CAL.—Plans have been authorized for the installation of an improved lighting system on Eighth Street. L. F. Gates is City Engineer.

LOS ANGELES, CAL.—The City Council has authorized the installation of ornamental lamps of pressed-steel type on Alvarado Street, requiring 102 standards.

LOS ANGELES, CAL.—Plans for the proposed new plant to be erected by the Davis Standard Electric Company at 1,058 Mignonette Street, to cost about $110,000, include a power plant, electric ovens, conveying machinery, etc. C. C. Ruppenthal, 2075 West Washington Boulevard, is architect.

MADERA, CAL.—The directors of the San Joaquin River Water Storage District have commissioned A. J. Wiley, Boise City, Idaho, consulting engineer, to prepare plans for a proposed power dam and hydro-electric power development on the San Joaquin River.

REDWOOD CITY, CAL.—The Pacific Gas & Electric Company has authorized plans for a power substation on West Point Slough, to cost about $115,000. It also plans to build another local substation, to cost about $27,000.

SACRAMENTO, CAL.—The City Commission is considering the installation of an ornamental lighting system on Fourth Avenue from Freeport Boulevard to Twenty-second Street. Albert Givan is city engineer.

SAN FRANCISCO, CAL. — The Engels Copper Mining Company, Mills Building, plans to install electric power equipment at its plant in Plumas County in connection with proposed extensions, to cost about $500,000.

SAN FRANCISCO, CAL.—The California Oregon Power Company has issued $1,500,000 in bonds, part of the proceeds to be used for the construction of a 40,000-hp. hydro-electric power plant on the Klamath River at Copco, Ore.; to erect an 82-mile, 110,000-volt transmission line from Delta, Cal., to the proposed new plant, and to complete another hydro-electric plant which is to be put into operation within the next few months.

SAN GABRIEL, CAL.—Bids will be received by the Board of City Trustees until July 8 for the installation of an ornamental lighting system on Las Tunas Drive and six other thoroughfares, using pressed-steel standards.

VALLEJO, CAL.—Plans are being prepared for an ornamental lighting system on Marin Street between Capitol and Georgia Streets.

VENICE, CAL.—Plans are under way for the installation of a new lighting system on Ocean Front from Navy Street to Horizon Avenue.

Canada

DUNCAN, B. C.—The possibility of developing hydro-electric power at Skutz Falls on the Cowichan River is reported to be under consideration by the City Council.

FORD, ONT.—Plans are under consideration to extend the street-lighting system on Sandwich Street and Drouillard Road, to cost about $25,000. J. F. Foster is City Engineer.

Electrical Patents

Announced by U. S. Patent Office

(Issued May 27, 1924)

1,495,279. PRESSURE CONTROL FOR GASEOUS DISCHARGE DEVICES; H. J. van der Bijl, New York, N. Y. App. filed Aug. 7, 1920. As vacuum tubes.

1,495,295. TELEPHONE CIRCUITS; H. Fletcher, New York, N. Y. App. filed April 1, 1920. Having provision for signaling.

1,495,332. ELECTRIC HAIR-WAVING APPARATUS; L. R. Koegel, Tours, France. App. filed Feb. 27, 1923.

1,495,376. COMBINATION TROLLEY SHOE AND WHEEL; A. I. Woodring and W. G. Lamb, Waterloo, Iowa. App. filed Sept. 29, 1923.

1,495,391. COMBINED READING AND INDIRECT ROOM-LIGHTING LAMP; F. C. Baker, Portland, Ore. App. filed June 7, 1922.

1,495,410. PROCESS OF AND APPARATUS FOR THE MANUFACTURE OF SULPHATE OF LEAD; J. Gitsham and H. R. Evershed, Launceston, Tasmania, Australia. App. filed May 8, 1922. Using an electric furnace.

1,495,416. ELECTRIC RAILWAY SYSTEM; W. V. Hunt, Vancouver, B. C., Canada. App. filed Feb. 19, 1923. Direct current.

1,495,420. INDUCTION MOTOR; J. D. Lewis, Yonkers, N. Y. App. filed May 20, 1918. With stator winding arranged to produce different pole numbers.

1,495,421. AUTOMATIC POWER REGULATOR FOR ELECTRICALLY HEATED APPARATUS; O. J. Marshick, Detroit, Mich. App. filed Nov. 1, 1920.

1,495,422. TRANSMISSION CIRCUITS; R. C. Mathes, New York, N. Y. App. filed July 15, 1921. Employing amplifiers or repeaters.

1,495,429. PIEZOPHONY; A. McL. Nicholson, New York, N. Y. App. filed April 10, 1918. As adapted to submarine signaling, etc.

1,495,434. ELECTRICAL DEVICE; W. S. Pfeifer, Milwaukee, Wis. App. filed July 18, 1921. For operation in connection with a clock to maintain the spring under substantially constant tension at all times.

1,495,436. SPARK-PLUG TESTING AND INDICATING DEVICE; E. M. Plummer, Chicago, Ill. App. filed March 17, 1921.

1,495,447. ELECTRICAL FIXTURE; E. O. Schweitzer, Chicago, Ill. App. filed May 5, 1919. Multiple-connector type.

1,495,465. DEVICE FOR THE ELECTRIC HEATING OF LIQUIDS; R. von Brockdorff, Munich, Germany. App. filed Dec. 3, 1920. Where the liquid itself forms the resistance.

1,495,466. ELECTRICAL TESTING SYSTEM; E. C. Wente, New York, N. Y. App. filed April 7, 1921. For measuring the phase angle and voltage magnitude of small alternating currents.

1,495,470. HIGH-FREQUENCY TRANSMISSION; J. F. Farrington, New York, N. Y. App. filed Feb. 1, 1922. As in radio-telephone systems for two-way conversation and other similar systems employing carrier waves.

1,495,493. SOLDERLESS GROUND CLAMP; G. Lipschutz, Philadelphia, Pa. App. filed Jan. 11, 1923.

1,495,503. ELECTRICAL FURNACE AND REMOVABLE HEATING UNIT THEREFOR; P. A. E. Armstrong, Loudonville, N. Y. App. filed March 25, 1920.

1,495,511. CONDENSER; R. J. Fitzgerald, New York, N. Y. App. filed May 12, 1920. Variable type.

1,495,512. ELECTIC LIGHTING SYSTEM; E. Fuchs, Paris, France. App. filed Dec. 31, 1919. Safety devices as used in automobiles and other vehicles.

1,495,514. ELECTRIC LIGHT FIXTURE; F. Gunnison, Brooklyn, N. Y. App. filed April 14, 1921. Ceiling type.

1,495,533. X-RAY TUBE; O. A. Roensch, Newark, N. J. App. filed Jan. 4, 1919. Using a tubular static shield.

1,495,537. DOUBLE-HELIX CAGE ANTENNA; S. F. Stafford, Medford Hillside, Mass. App. filed Aug. 21, 1923.

1,495,541. BASE FOR TOY TELEPHONES; C. M. Watrous, East Hampton, Conn. App. filed June 8, 1922.

1,495,563. APPARATUS FOR TREATING GASES; H. D. Rankin, Coronado, Cal. App. filed Nov. 22, 1920. With the electric arc.

1,495,568. SILICATED SEPARATOR AND PROCESS OF MAKING THE SAME; R. C. Benner, Bayside, N. Y. App. filed March 28, 1923. For the electrodes of storage cells.

1,495,572. ELECTRIC RADIATOR; A. Bourgain, Paris, France. App. filed May 1, 1923. Resistances incased and heat radiated from elements by conduction.

1,495,577. ELECTRICAL CONDENSER; F. W. Dane, Hamilton, Mass. App. filed April 3, 1920. Method of manufacture.

1,495,583. BATTERY CHARGER; E. W. Engle, Lake Forest, Ill. App. filed Aug. 19, 1922. Electrolytic type.

1,495,585. OPERATOR INSTRUCTION CIRCUITS; C. B. Fowler, New York, N. Y. App. filed Dec. 31, 1919. Telephone-exchange system.

1,495,586. LAMP LOCK; F. J. George, Everett, Wash. App. filed June 14, 1920.

1,495,591. ELECTRIC SOCKET; J. Hohl, Newark, N. J. App. filed Aug. 29, 1923.

1,495,593. RADIO-TELEGRAPH TRANSMITTING SYSTEM; L. M. Hull, Chevy Chase, Md. App. filed Oct. 16, 1920.

1,495,597. TESTING SYSTEM; K. S. Johnson, Jersey City, N. J. App. filed Jan. 16, 1920. Electric signaling and telephone systems.

1,495,616. ART OF MEASURING THE VELOCITY OF TERRESTRIAL BODIES RELATIVE TO EACH OTHER; F. G. Simpson, Seattle, Wash. App. filed May 23, 1923.

1,495,619. DEVICE FOR TESTING ELECTRIC CIRCUITS; A. W. Thaw, Norwood, Ohio. App. filed June 25, 1923. As ignition circuit of an automobile engine.

1,495,647. COMBINATION PILOT LIGHT AND ILLUMINATING LIGHT FOR ELECTRIC RANGES; S. D. Robinson, Hamilton, Ontario, Canada. App. filed May 24, 1923.

1,495,657. CURRENT-COLLECTING DEVICE; C. F. Wagner, Pittsburgh, Pa. App. filed Feb. 20, 1923. For slip rings, etc.

1,495,658. HEATER; R. L. Wilkinson, Amarillo, Tex. App. filed Aug. 31, 1922. For heating a fluid during its passage through the heater and to de-energize the heating element if the water is cut off from the heater.

1,495,681. ELECTROLYZER FOR PRODUCING HYDROGEN AND OXYGEN; G. Fauser, Novara, Italy. App. filed April 11, 1922.

1,495,685. OVEN AND ELECTRIC HEATER THEREFOR; F. Graf, Baden, Switzerland. App. filed Nov. 9, 1920.

1,495,691. ELECTRIC LIGHT CLUSTER SOCKET; M. Herskovitz, Chicago, Ill. App. filed July 23, 1918.

1,495,701. ROSETTE FOR ELECTRIC WIRING; C. D. McLean, Berlin, N. H. App. filed Aug. 19, 1920.

1,495,746. REGULATING APPARATUS; G. E. Hulse, Newark, N. J. App. filed Oct. 19, 1920. For electrical systems of distribution as in railway car lighting.

1,495,749. ELECTRODE AND METHOD OF JOINTING SAME; B. G. Klugh, Chicago, Ill. App. filed Nov. 8, 1920.

1,495,755. AUTOMATIC TELEPHONE EXCHANGE; F. A. Lundquist, Chicago, Ill. App. filed Sept. 27, 1919.

1,495,764. DYNAMIC BRAKING; B. O. Austin, W. M. Hutchison and H. R. Meyer, Wilkinsburg, Pa. App. filed Aug. 18, 1921.

1,495,766. CONTROL SYSTEM; E. M. Bouton and G. W. Hurtt, Wilkinsburg, Pa. App. filed June 9, 1919. For compound-wound, direct-current motors.

1,495,770. BUSBAR SUPPORTING STRUCTURE; J. M. Brown, Pittsburgh, Pa. App. filed June 19, 1918. Unitary structure.

1,495,778. LIGHTING FIXTURE; G. Butzke, Alplaus Road, N. Y. App. filed Jan. 28, 1921.

1,495,779. IGNITION SYSTEM; H. R. Davies, Toledo, Ohio. App. filed Aug. 8, 1917. For automobiles.

1,495,780. CURRENT-COLLECTING DEVICE; O. H. Eschholz, Wilkinsburg, and E. B. Shand, Pittsburgh, Pa. App. filed April 16, 1923. For slip rings.

1,495,784. MAGNETIC MEANS FOR PRODUCING, MODIFYING AND TRANSMITTING MECHANICAL MOVEMENTS AT VARIABLE SPEEDS; H. J. Fereday Upper Tooting, London, England. App. filed Jan. 6, 1921.

1,495,787. MOTOR-CONTROL SYSTEM; C. Le G. Fortescue, Pittsburgh, Pa. App. filed Oct. 18, 1920. As on electric locomotives.

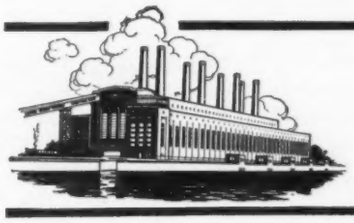
1,495,788. VEHICLE MOTOR CONTROL; F. Franz, New York, N. Y. App. filed Dec. 16, 1921.

1,495,790. MOTOR-CONTROL SYSTEM; A. L. Harvey, Wilkinsburg, Pa. App. filed March 13, 1920. As employed with adjustable-speed, direct-current motors.

1,495,792. MEANS FOR RECEIVING ALTERNATING-CURRENT SIGNALS; F. E. Pernot, London, England. App. filed July 11, 1923. Reception of signals of a definite frequency or within a definite range of frequencies.

1,495,795. THERMOCOUPLE; R. T. Pierce, Swissvale Station, Pa. App. filed March 23, 1921. Thermocouple bulb in which the elements have negligible temperature coefficients of resistance.

1,495,802. ELECTRIC HEATER UNIT; T. A. Reid, Wilkinsburg, Pa. App. filed Sept. 23, 1922. For resistance furnaces.



POWER

Stone & Webster power stations designed and built, or now being built, total one and three-quarter million horse power—enough to operate the traction systems of New York, Chicago, Philadelphia, Detroit, Cleveland and St. Louis—our six largest cities.

Under construction is over 300,000 horse power. This is to supply Boston, Washington, Hartford, Lynn, Indianapolis, Fall River, Los Angeles and other cities.

Sixty public service corporations are served continuously by Stone & Webster engineers who make their plans and install their new generating and distributing equipment.

Stone & Webster engineers have examined and appraised properties to the total value of more than $4,500,000,000 including many of the country's foremost public utilities.

STONE & WEBSTER

INCORPORATED

DESIGN · BUILD
MANAGE
FINANCE

NEW YORK, 120 Broadway
SAN FRANCISCO, Holbrook Bldg.
CHICAGO, 38 S. Dearborn Street
PHILADELPHIA, Real Estate Trust Bldg.
BOSTON, 147 Milk Street

DEVELOPMENTS 1923

cover, while the batteries are in the rear. Having a complete weight of but 18 lb., the set is made easily portable by the addition of a leather carrying handle.

Developments in the line of commercial receivers included the standardization of those used in the trans-Atlantic and trans-Pacific stations of the Radio Corporation of America.

Carrier Current

The carrier current system of telephony, which effects communication by means of high-frequency currents superimposed on the power conductors of transmission lines, was applied over greater distances than heretofore by the production of a 250-watt transmitter, and receiving equipment. The rating of the previous outfit was 50 watts and its maximum range in an actual installation was 88 miles.

With the larger equipment service is now being maintained over distances up to 116 miles, with apparatus under construction for communication over 138 miles. The progress already made in this new method of telephoning is indicated by the fact that it has already been adopted for 70 transmission lines with an aggregate length of over 2000 miles.

Battery Chargers

A new constant potential motor-generator 7½/15-volt battery charging outfit was produced, which includes a special regulator to maintain the voltage constant at the busbars, regardless of the number of batteries being charged.

This permits the use of shunt windings only on the generator thereby obviating any possibility of the reversal of polarity during power failure. The voltage to be held by the regulator is adjustable by means of a thumb screw.

The "Magnar", which is a mechanical rectifier of the vibrating type, used principally for charging storage batteries in railway signal service, was only experimentally installed in 1922, but during 1923, as a result of their demonstrated reliability, several thousand were utilized on more than 75 railway systems with entire success. Among the larger railroads, 1000 were supplied to the Illinois Central and 600 to the New York Central.

For charging the batteries of electric vehicles there was produced and standardized a new dead front type of panel board, made up of removable steel sections.

Lighting

The volume of sales of incandescent lamps serves as a reasonably accurate measure of the expansion of the lighting business. It is estimated that about 225,000,000 large tungsten filament lamps were sold in the United States during the year 1923. This is nearly 11 per cent increase over 1922, and exceeds any previous year. The figures do not include the sale of miniature lamps, which are used in large numbers for automobiles, flashlights, etc. The sales of carbon lamps are also excluded, since they have shrunk to an insignificant number.

The construction of the more important types and sizes of tungsten lamps was changed to eliminate the tip on the bulb, thereby reducing liability to breakage and improving the appearance of the lamps. The change necessitated extensive changes in certain processes of lamp manufacture, requiring new machinery and apparatus.

A new method of making the popular sizes of lamps was adopted by some of the lamp manufacturers. Formerly, individual machines and departments performed particular processes, the lamps or parts being transported from one location to another, between steps of manufacture. This required considerable floor space for storing and handling. With the new method of manufacture, the various parts of a lamp are made and assembled on a single "unit" machine.

In the sign lamp, the shape of the filament was changed to a coil ring form which makes the filament mechanically stronger and increases the end-on candle-power of the lamps. As used in signs, the spots of light appear larger and, when properly spaced, the appearance is more nearly a continuous line of light than that secured with previous types.

The healthy growth of the miniature lamp business during the year is indicated by the increase in sales to about 110,000,000 as compared with 85,000,000 for 1922, that is, an increase of about 30 per cent. Of the lamps sold in 1923, about 20 per cent were for flashlight service, 12½ per cent for Christmas tree decoration, and 65 per cent for automobile service, the remaining 2½ per cent being of miscellaneous types.

Street Lighting

The year was notable in many respects in street lighting history. Traffic has continued to multiply so rapidly that the present systems of lighting on thoroughfares in most cases are inadequate and in an effort to correct this condition and relieve night congestion of traffic, many cities have realized the necessity of revamping their entire street lighting systems.

In all of these cities there was a noticeable trend toward high intensity lighting in the business districts. The effect of such systems on the character of modern street lighting can be readily appreciated by the increase in the light intensity on some of the streets recently equipped as indicated by the following Table:

INCREASES IN INTENSITY OF ILLUMINATION AS COMPARED WITH SUPERSEDED SYSTEMS

Market Street, Lynn	18 times
Broadway, Saratoga	15 times
Market Street, San Francisco	15 times
Triangle District, San Francisco	12 times
South State Street, Chicago	11 times
Main Street, State Street and Broadway Salt Lake City	8 times
Broadway, Los Angeles	6 times

For the complete story of G-E developments during 1923 ask for Publication X-767

ELECTRIC

ENGINEERING

inches in diameter and requires 250,000 volts to puncture.

The previous maximum potential for conductor cable in the United States was 44,000 volts, cable of this rating being utilized for the underground circuits of the New York Edison Company.

High Voltage Direct Current Cable Testing Sets

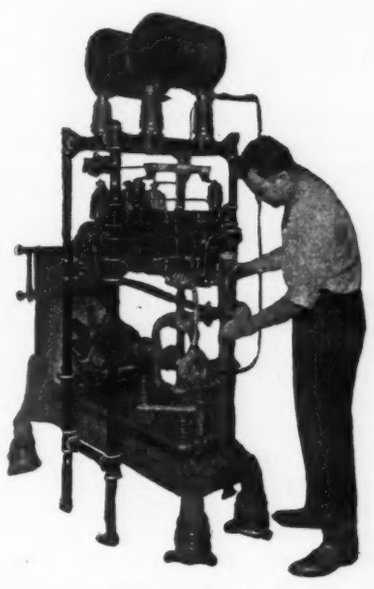
The purpose of direct current testing sets is to permit power companies to make satisfactory periodic test of underground cables, to determine the condition of insulation between conductor and ground and to locate cable faults and measurements of insulation resistance. Three types of equipment were developed and standardized for this service.

For station use, to be considered as a stationary outfit, a four-kenotron 200,000-volt set was designed, each kenotron being capable of rectifying 250 amperes direct current.

For cable testing this set is used in the following manner. During one half cycle the current flows through two kenotrons in series and charges one conductor, during the other one half cycle current flows through the other two kenotrons and charges the other conductor with the reversed polarity, so that the voltage between the conductors will be twice the crest value of the transformer voltage. The voltage across the two kenotrons in series on the reverse wave will be the transformer voltage plus the voltage from the conductor to ground, which will be a maximum of 200,000 volts.

The direct-current voltage is measured by special meters which measure the crest value of the voltage wave obtained from the voltmeter coil. Two meters are used, each meter reading the voltage from conductor to ground and the voltage between conductors is the sum of the two readings of the voltmeters. The current supplied to the cable is measured by two ammeters connected between the ground and the transformer winding. In series with each meter is a Tungar rectifier which divides the current so that one half wave flows through one meter and the other half wave flows through the other meter. In this way the current which is supplied to each conductor is measured separately.

A smaller set rated at 100,000 volts and 100 M.A. is semi-portable and can be moved around a station or moved from one station to another by truck. It functions in essentially the same manner as the 200,000-volt set, except that it is limited to lower voltages and current and only two kenotrons are used.



WATER-COOLED TUBE UNIT FOR 20 KW. TRANSMITTER

For portable testing a 30,000-volt set, using the 100-M.A. kenotron, was designed primarily for measuring insulation resistance and not for high-potential testing. By means of this type of equipment it is possible to locate cable faults which can later be given further tests by means of one of the higher power equipments.

Radio

The improvements in vacuum tubes for radio purposes were mostly in the direction of increased efficiency of operation and a general betterment of electrical characteristics.

It is also interesting to note that during the year there was started in regular production a new tube of the highest power so far standardized, and also the smallest tube requiring the least power expenditure in the filament that has so far been made available for radio receiving sets.

The smallest standard receiving tube, UV-199, operates with an expenditure of only 0.18 watt for the filament, which is of a new type and insures high electron emission, silent operation and long life.

The development of the new filament made possible the remodeling of the Radiotron UV-201, the previous standard receiving tube, so that it only required one-quarter the former amount of filament power. At the same time the characteristics of the tube were changed so that it became a better detector and amplifier.

A loud speaker was developed for use as an addition to sets not already equipped with one. It is very sensitive and reproduces signals with clear quality and a single adjustment is provided for the diaphragm, which gives good operating efficiency over a considerable range of signal intensities.

Early in the year, the requirements for receivers took on a new aspect. Portable and self-contained receivers had become possible due to the new tube developments, and these suddenly were widely demanded. The receiver designed to meet this need, utilizes a single-circuit regenerative system with a detector and an audio-amplifier tube, functioning well over the broadcast range. The method of control is exceptionally simple. The telephones and plug are carried in the front

General Electric Company Schenectady, N. Y. Sales Offices in all Large Cities

GENERAL

DEVELOPMENTS 1923

was somewhat reduced as compared with 1922. The table shows the average rating for the past five years.

Year	Self-Cooled	Water-Cooled	All Types
1919	1175	4325	2150
1920	1325	3175	2175
1921	1575	4150	2750
1922	1700	6000	3750
1923	2350	5125	3220

At the close of the year there had been completed or were under construction a total of more than 180 units of 10,000 kv-a. or above.

Induction Voltage Regulators

A new design single-phase induction voltage regulator was developed, which embodies a number of improvements as compared with previous types. In addition to improving the voltage regulation by a more rapid correction of voltage changes, it utilizes a tank which is highly resistant to rupture as a result of explosions, and a rigid internal mechanical structure to minimize noise during operation. An improved method of bracing the coils prevents insulation troubles due to line short circuits.

Lightning Generator

The lightning generator installed in the High Voltage Laboratory of the Pittsfield Works will produce voltages of approximately 2,000,000 above ground. This is perhaps higher than lightning voltages that are usually produced on transmission lines. These voltages are of a known wave shape and duration. The wave front is under control and may be made so steep that the voltage starting at line voltage may be made to increase at the rate of 50 million million volts per second. The rate that energy is dissipated in the arc is generally of the order of millions of horse power. The duration of such discharges is conveniently measured in microseconds.

Lightning Arresters

A new type of oxide film arrester, known as the pellet arrester, was developed commercially. In this arrester, the lead peroxide, which is the active element of the oxide film type of arrester, is utilized in the form of small pellets about one-eight of an inch in diameter, which are covered with litharge. This litharge coating acts like the varnish film on the plate type of oxide film arrester and thus each pellet becomes a small oxide film cell. The pellets are put into a porcelain container and are connected to the line through a gap.

Electrically Operated Flow Meters

A type of electrically operated flow meter with many new characteristics was developed for accurately measuring the total flow of steam, water, air, gas, oil, etc., through pipes and so furnishing information of great value in the economical management of any manufacturing industry or central station. It does not supersede the G-E mechanically operated flow meter, but is simply an addition to existing types.

Due to the electrical principle of operation the indicating, curve drawing and integrating instruments can be located at any distance away from the pipe where the flow is being metered and the instruments can be either separated, grouped or duplicated.

X-Ray Tubes

A new tube having fifteen times the X-Ray energy of the average tube now in commercial use, was produced for therapeutic work.

It is rated 250,000 volts, 50 milli-amperes, and is provided with cooling coils which carry the circulating water direct to the back surface of the anode. It is the first high-voltage tube equipped with a cooling system of this type.

The new tube has not yet been developed commercially but has been used experimentally for several months. The previous maximum size, rated 200,000 volts, 8 milli-amperes, is now in commercial production.

Photo Electric Cell

An extremely sensitive photo electric cell was developed, consisting of a small bulb into which two electrodes are sealed. The inside walls of the bulb are coated with silver with the exception of a very small area which is kept clear for the passage of light.

The action of light focused on the cell through the clear spot causes increasing electron discharge from cathode to anode with potentials as low as 50 volts. Due to the sensitivity of the cell very slight variations of light cause the current to change very rapidly. By using vacuum tube amplifiers the current from the cell can be increased to any value desired.

This photo-electric cell has already been applied commercially in the mechanical sorting of cigars according to color. The process is as follows: The cigars are carried on a mechanical conveyor and at a certain point a beam of light strikes a cigar. The light reflected from the cigar falls on the eye of a photo-electric cell and since the cell current changes as the light intensity varies, the current from the cell, through an amplifier, causes the mechanical gates to operate through which the cigars fall into boxes graded according to color. By means of this device it is possible to sort cigars much faster and more accurately than by hand or by any other method heretofore devised.

Conductor Cable

As the result of exhaustive research work, the manufacture of 66,000-volt single-conductor cable was for the first time placed on a commercial basis.

The cable produced was for the Cleveland Electric Illuminating Company and can transmit upwards of 33,000 kw. at 66,000 volts. It is slightly over three

For the complete story of G-E developments during 1923 ask for Publication X-767

ELECTRIC

GE ENGINEERING

Induction Furnaces

The new type of induction furnace, which utilizes the force of electro-magnetic repulsion existing between transformer primary and secondary windings, to cause a circulation of molten metal between the heating circuit and the melting pot, was operated only experimentally during 1922.

Fifteen 75-kw., 1200-lb. induction furnaces were placed in commercial operation for melting nonferrous metals in 1923 and a number of additional units were under construction.

A notable accomplishment of the repulsion-induction furnace was the successful melting of pure copper on a commercial basis.

The largest horizontal ring type induction furnace in the United States was built for installation at the Allegheny Steel Company. It has a maximum capacity of six tons and in normal service will melt three tons every three hours.

Industrial Heating

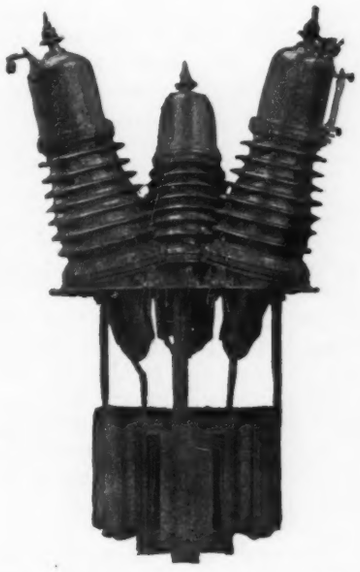
The electric furnace was for the first time successfully used for bright annealing of copper wire.

Another special furnace was developed for annealing steel punchings used for field and armature laminations. It is built 6 ft. above the floor on a structural steel support, and the laminations are placed on a car which is rolled under the furnace and raised into the heating chamber on a hydraulic platform. Around the edge of the car is a sand seal which makes the furnace air tight when the car is in place.

Transformers

The recent tendency to concentrate the transformation of electrical energy in units of increasing capacity was evidenced by the construction of a large number of transformers of record size. A notable event of the year was the placing in service of the 220,000-volt units at Power House No. 8 of the Southern California Edison Company's system from which approximately 20,000 kw. was initially transmitted to Eagle Rock substation near Los Angeles.

There were under construction two self-cooled, three-phase, 60-cycle units which will transform 15,000-kv-a. as auto-transformers from 72,000 volts Y to 132,000 volts Y with solidly grounded neutral. Both of these windings will have taps. They will also transform 15,000 kv-a. from either



METERING OUTFIT (REMOVED FROM TANK) FOR 90,000-VOLT. SYSTEM OF PARIS-ORLEANS RAILWAY

of the high-voltage windings to 12,470 volts and simultaneous operation on all three windings is possible. These transformers are larger in physical dimensions and in kv-a. rating than any self-cooled transformers heretofore built, the largest previous rating being 12,000 kv-a.

Seven 60-cycle 10,417-kv-a. single-phase, self-cooled auto-transformers of unusual construction were built for the Brooklyn Edison Company. They step up the generator voltage from 13,800 volts to 27,600 volts and have a normal rating of 10,417 kv.-a, but since they are auto-transformers of a one to two ratio, each will transform a total of 20,834 kv-a. so that the total output of a bank of three units will be 62,502 kv-a. This is probably the largest amount of energy transformed by a single bank of self-cooled transformers.

The maximum capacity for single-phase, water-cooled transformers was increased by the construction of ten units, rated 22,000 kv-a., 39,500/68,500/2300 volts, 25 cycles for the Niagara Falls Power Co.

A three-phase air-blast transformer exceeding all previous units in both capacity and physical dimensions, was built for the New York Edison Company. It is rated 17,100 kv-a., 11,800/2950 volts, 25 cycles.

There was further demonstration of the value of concentric circular windings for extra high-voltage transformation. The marked advantages of this type over the oil interleaved (sandwich) type had been brought out in studies of impressed high-voltage transients on commercial transformers, this work being carried on in the high-voltage laboratory of the Pittsfield Works. The unique equipment of this laboratory has placed high-voltage transformer design on a scientific basis heretofore unattainable and has made possible the absolute checking of calculated phenomena.

An unusual arrangement of instrument transformers was provided for metering energy on the high-potential side of substations on the Paris-Orleans Railway. Four 60,000-volt transformers each have three current and two potential transformers while two 90,000-volt units have three each of current and potential transformers mounted in a single tank with three high-voltage leads.

The 90,000-volt arrangement is unique in that the three current transformers are located inside the porcelain bushings, whose headers also serve as oil conservators.

The average unit size of self-cooled transformers continued to increase but due to specific conditions the average for all types

General Electric Company Schenectady, N. Y. Sales Offices in all Large Cities

GENERAL

DEVELOPMENTS 1923

Among the more important of the new designs is a starting switch for three-phase motors, sizes up to 7½ h.p., 440 and 550 volts, which is of the positive quick-make and quick-break tumbler type, totally enclosed with the operating handle on the front and a locking plate on the side so that it may be locked to prevent either the opening of the box, the closing of the switch, or both.

An ingenious design of a magnetic switch provided with a thermal overload relay was developed to meet the demand for starters of compact construction and for mounting in the frames of machines. It is suitable for motors up to 10 h.p., 550 volts, 25 to 120 cycles, and the units can easily be arranged on panels so as to insure complete control, at any point desired, of machines driven by two or more motors of either the same or different ratings.

Motor Applications

To meet the requirements of the Russian Government in regard to electrical equipment for oil well drilling, two totally enclosed induction motors were developed, rated 75 h.p. and 50 h.p., 750 r.p.m., with a temperature rise of 45 deg. C. These motors are unique in that they are the largest totally enclosed, self-ventilated motors yet manufactured, previous designs in these sizes having employed water as a cooling agent.

The H. C. Frick Coke Company is installing a belt conveyor approximately five miles long for transporting coal from the mine workings to the shipping station. It consists of twenty sections, each driven by an induction motor. The motors vary in size from 50 to 175 h.p. and are all of the wound rotor type. Solenoid brakes are provided for stopping and holding the conveyor belts when power is cut off from the motors and the control is so arranged that the motors start in sequence beginning at the delivery end. As each motor reaches full speed, it energizes the starting circuit of the next succeeding motor. If any motor stops, it automatically stops all the motors preceding it in the conveyor system but allows those following it to run and clear the belts of coal.

Electrical equipment was provided in 1923 for two direct-current coal tower hoists for the new Hudson Avenue Station of the Brooklyn Edison Company to give a hoisting rope speed of 1460 ft. per min. and a lowering rope speed of 1680 ft. per min. on the 200-ft. lift and to give a guaranteed delivery of 250 tons per hour, using a 2.5 ton grab. The hoist motor is rated 625 h.p., is direct connected to the hoisting drums and takes its power from a 575-kw. motor-generator set mounted in the tower and driven by a 700-h.p., 2300-volt, 3-phase, 60-cycle induction motor.

A noteworthy installation of motor drive and control was made at the plant of the *Public Ledger*, Philadelphia, Pa. for operating a battery of new printing presses. This equipment in size, arrangement and construction details is unusual and represents a distinct advance over previous practice. An improved form of control is employed, embodying the new bent frame contactors and relays which were designed especially for this service together with a simplified and improved form of pilot motor operating mechanism.

Steel Mills

There was added to the existing main roll drives, 300 h.p. and over, 44,100 h.p. (normal continuous rating), bringing the total to 612,110 h.p. The tendency towards the use of high-speed motors with reduction gears, which has been quite marked for the last few years, continued to gain headway and over 90 per cent of the new motors were for geared drive.

One of the most important developments of the year was the building of alternating-current brush-shifting motors with shunt characteristics. Two machines of this type, which gives adjustable speed without auxiliary apparatus, were under construction for the Halcomb Steel Company, Syracuse, New York, for driving merchant mills, and are rated 600/400/200 h.p., 321/214/107 r.p.m., 440 volt, 25 cycle and 500/385/250 h.p., 130/100/65 r.p.m. for the same power supply. There has long existed a need for an adjustable speed alternating-current motor that was simple and did not require a large amount of auxiliary equipment, and whose speed would be practically independent of its load. This machine is the first practical piece of apparatus to meet these requirements.

Electric Welding

The most important achievement in arc welding was a radical improvement in the construction of the electrode. As the result of exhaustive research and experiment, a mechanical construction was developed which makes it easy to combine the desired welding flux within the body of the electrode, thus securing all of the advantages which could be obtained with an externally coated electrode, without its disadvantages.

The results of this research work were made available commercially by the development of new methods of manufacture, the ingredients of the fluxes being fused together in an electric furnace, finely ground and mixed with suitable solvents. Special machines were developed for applying the sheath to the core while feeding in the exact amount of flux required to fill the intervening space. These machines have attachments for straightening and cutting the finished electrodes, where these are to be used for hand welding, while the finished electrode material for use with automatic welding machines is wound on reels in continuous lengths.

For the complete story of G-E developments during 1923 ask for Publication X-767

ELECTRIC

GE ENGINEERING

the relay has functioned to trip the particular circuit which it controls. The contacts are definitely geared to the shaft. The holding coil of these relays, therefore, does double duty in that it holds the contacts closed after they have once been closed in any cycle of operation and also operates the target. This relay can also be provided with under-voltage protection.

Waterwheel Generators

The first of the two 65,000-kv-a. 12,000-volt, 25-cycle, 107-r.p.m. waterwheel generators for the Niagara Falls Power Company was completed and shipped in sections to the power site for assembly. It is the largest machine of its type, both in capacity and physical dimensions, so far constructed.

An unusual thrust bearing construction was provided for two 8200-kv-a., 150-r.p.m. and two 15,000-kv-a., 120-r.p.m., 6600-volt generators for the Phoenix Utility Company for installation in Alexander, Idaho and Fond du Lac, Minnesota. The upper bearing bracket which is ordinarily used to hold the suspension thrust bearing was omitted altogether in these machines and the bearing was located in the lower bracket between the rotor and the waterwheel, the lower bracket being strengthened for the exceptional service required of it. This arrangement permits ready access to the stator coils for inspection or replacement as the rotors of the smaller machines or the stators of the larger ones can be lifted with an overhead crane by the removal of a few bolts.

STATOR CASTINGS OF 65,000-KV-A. WATERWHEEL-DRIVEN GENERATOR ARRANGED ON TURNTABLE FOR MACHINE WORK

Frequency Converters

A frequency converter of exceptional capacity and unusual characteristics was constructed for tying together the 25 and 60-cycle systems of the United Electric Light & Power and the New York Edison Companies.

The induction type unit will supply 150,000 kv-a. to the 60-cycle system with a short circuit on the 60-cycle bus and with 25-cycle bus voltage maintained. In the reverse direction, it will supply 191,000-kv-a. to the 25-cycle system with 60-cycle bus voltage maintained. The induction unit will be excited from the 25-cycle synchronous generator and the set is designed for unity power-factor, input and output in either direction at full load.

The kilowatt capacity of the set is nearly three times that of the largest frequency converter previously built, and marks a new epoch in the construction of horizontal-shaft alternating-current machines.

Industrial Motors

The single-phase motor is an important factor in many industrial applications but early designs had certain electrical and mechanical characteristics which tended to limit the field of its practical utility. A new type single-phase motor which operates on the squirrel cage induction principle was developed which eliminates entirely the short-circuiting switches heretofore considered essential and permits the simplest possible construction.

A complete new line of 40-degree continuous duty riveted frame polyphase motors in sizes up to 15 h.p. was designed with numerous improved electrical and mechanical characteristics as compared with previous construction for this class of motor.

During the year considerable work was done towards standardizing the bores of small high speed motors used generally by the woodworking trade. Through the efforts of several of the electrical companies, most of the tool manufacturers are now using a definite bore for these shaftless motors. Before this standardization, there were a great many different bore dimensions for the same frame, which was decidedly objectionable from a manufacturing standpoint.

Industrial Motor Control

A number of improvements were made in the apparatus designed for the control of industrial motors, which, despite the relatively small size of the individual controller, are of great economic value due to the vast extent of the field of present day industrial motor application.

General Electric Company Schenectady, N. Y. Sales Offices in all Large Cities

GENERAL

DEVELOPMENTS 1923

tion of a new type of overhead was made. The outstanding characteristics were the ability of this overhead to collect without sparking as high as 4000 to 5000 amperes on a single pantograph at speeds of from 50 to 60 miles per hour with a normal pressure of pantograph against the trolley wire of 30 to 35 pounds.

In order accurately and simultaneously to record the vertical and transverse thrust or impact of locomotive wheels on rails, an interesting device, called the Otheograph, was developed. Numerous tests under a variety of conditions have already been made with both steam and electric locomotives.

This instrument shows by graphic records the effect of each separate wheel of a locomotive or car on each of the two rails. These otheograph ties may be installed in place of the regular ties, either singly or several grouped together on curves or on tangent track.

The most effective aid to the rehabilitation of the electric railway system of the country was the remarkable progress in light weight car design. Some of these light weight installations such as the Cincinnati, Lawrenceburg & Aurora Street Railway, the Kentucky Traction & Terminal Company and others have been in service for a sufficient length of time to secure authentic operating data, which is most convincing. On the Cincinnati, Lawrenceburg & Aurora, for instance, savings over a period of 5½ years aggregated more than $220,000.

Automatic Railway Substations

The automatic railway substation continued to be popular with electric railways both in this country and abroad as was evidenced by a growing tendency to make electric railway systems completely automatic by installing automatic control for all substation units.

At the close of the year there were 70 railroad companies using G-E Automatic Substations with 225 equipments aggregating more than 170,000 kw. in capacity either in service or under construction. Thirteen railway companies each operate automatic substations with capacities of 4000 kw. or above.

Automatic Stations

There were many indications that the automatic station had become an accepted factor in the electrical industry as actual installations were more numerous than in preceding years, and many of the equipments built were of record capacity. Installations were also made in foreign countries for the first time.

The development of water power sources received more attention than ever before because of the high cost of fuel and labor and the need of additional sources of power to meet the needs of electrical expansion. Before the advent of the automatic station it was usually uneconomical to develop the water power sites of small capacity because of operating costs, but these small sites are now coming rapidly into prominence, and automatic hydro-electric stations are operating or being installed in nearly every state in the Union.

The largest single-unit automatic hydro-electric station in the world is being installed by the Adirondack Power & Light Corporation for their Sprite Creek Development near Little Falls, N. Y. It is rated 7500-kv-a., 6000-volt, 3-phase, 60-cycle, the largest previous equipment of this type being of 5000 kv-a. capacity.

The use of automatic substations in mining service was very decidedly increased and has fulfilled a real need in this particular field where trained operators are scarce, many comparatively small installations are required to meet operating conditions, and where the power output must be reliable.

The increase in automatic substation installations created a corresponding demand for centralized supervision in large power systems and two main classes of equipment were standardized for this service. The first class is called the selector type and is suitable for installations in which few operations are required per station and where the stations cover a wide area. The second class is called the distributor type and is best suited for power systems where a large number of operations per station are required and the stations are within a radius of twenty miles.

Switching Apparatus

The developments in switching apparatus consisted largely in the improvement of existing designs rather than in bringing out strictly new types of apparatus. Both horizontal and vertical isolated phase arrangements were worked out in detail for several important installations and the application of breakers to removable trucks was extended to include motor operated breakers with separating chambers.

An example of unusual design, rendered necessary by the high cost of real estate, consists of an equipment of 28,000-volt, triple-pole, oil circuit breakers which, including the control and operating mechanism, occupy a space just five feet square, but rise to a height of 58½ feet.

They are intended for the Hudson Avenue Generating Station of the Brooklyn Edison Company. The departure from the regular arrangement is found in the location and the control, rather than in the breaker units themselves, for these are of standard tank type construction. They are placed one above the other, one phase to a floor, with the operating mechanism on the fourth floor.

Relays

A new type of hinged armature relay was designed to function as a direct-current auxiliary relay and is of simple construction and very reliable in operation.

A new type of induction overload relay has as an outstanding feature a target which is "built in" the relay and indicates when

For the complete story of G-E developments during 1923 ask for Publication X-767

ELECTRIC

GE ENGINEERING

headers supplying other turbines at from 250 to 350 pounds. These machines are an entirely new departure and involve special boiler equipment. The turbines, however, are simple in design and present no obstacles to the ultimate success of the system adopted.

Supercharger

A new turbine supercharger for airplanes was designed and built specifically for extreme altitude operation. It is rated to feed sea level atmospheric pressure to the engine at a height of 35,000 feet, or about twice the rating of the one used in the previous American altitude record flight.

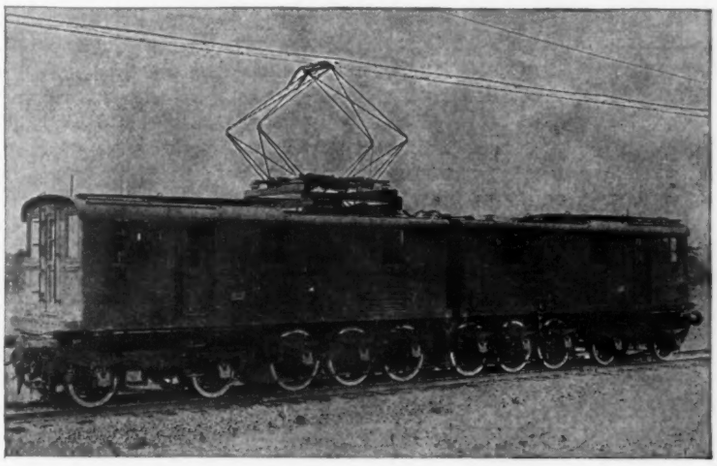
The supercharger consists of a turbine compressor mounted just back of the propeller blades of the plane on the front end of the Liberty motor and is operated from the red hot exhaust gases from the airplane motor, which ordinarily go to waste. It weighs about 140 pounds which might be considered a handicap in altitude flying but for the fact that at 35,000 feet its operation will increase the power of the Liberty motor by at least 280 horsepower or about two horsepower for each additional pound carried.

Electric Propulsion

Diesel-electric propelling equipments were adopted for two ships of a new type, built for refrigerating cargo service on the Great Lakes and New York State Canal System and for coastwise trade to the West Indies during the winter. The first of these ships, the *Twin Ports*, 258 ft. overall and 42 ft. beam with a full load draft of 13 ft. and a cargo capacity of 2600 tons, started commercial operation in September.

The electrical equipment comprises two 250-kw., 230-volt, 260-r.p.m. direct-current generators direct driven by two Diesel engines and two 250-h.p. motors direct connected to twin propeller shafts which give a speed of 13 miles per hour at full motor load.

Seven electrically propelled ferry-boats now in service after successful trials are showing excellent operating economies. One of these boats, the *Golden West*, running between San Francisco and Sausalito, which is rated as an 80 automobile boat and has Diesel-electric equipment, required 0.95 bbl. of fuel oil per running hour in comparison with a steam engine driven boat rated at 60 automobile capacity, on the same route and at the same speed, which consumed 3.35 bbl. per hour.



120-TON PASSENGER LOCOMOTIVE FOR PARIS-ORLEANS RAILWAY. THE HIGHEST-SPEED ELECTRIC LOCOMOTIVE, BUILT JOINTLY BY THE GENERAL ELECTRIC COMPANY AND THE AMERICAN LOCOMOTIVE COMPANY

At the close of the year there were G-E electric propelling equipments completed or under construction for 14 ships, making the aggregate rating of this class of machinery, from 1908 to date, more than 550,000 shaft h.p. for 45 ships.

Electric Railways

As in the preceding year the more important additions to main line electrification occurred in foreign countries and it is noteworthy that in a majority of cases the 3000-volt direct-current system was adopted.

Progress included the initial operation of 3000-volt equipment on the Spanish Northern Railway in Spain, six locomotives having been made ready for service during the latter part of the year. Two substations were also completed for supplying 3000 volts direct current for the operation of this line.

Ten 150-ton, 3000-volt locomotives for the Mexican Railway Company, Ltd., were completed and tested together with substation equipment which will be ready for operation by the time the first locomotives are placed in service.

In connection with the extensive electrification program being put through by the Japanese Imperial Government Railways, two locomotives weighing 66 tons each were placed in service.

Rapid progress was made in the manufacture of equipment for the Paris-Orleans Railways in France. The 120-ton, 1500-volt high-speed passenger locomotive was completed and tested and gave every indication of exceeding without difficulty all of the requirements for which it was designed. Speeds of more than 81 miles an hour, for which this locomotive was guaranteed, were made, and its riding qualities at high speeds surpass those of any electric locomotive ever built.

An event of considerable interest and importance to engineers connected with heavy steam road electrification was a series of tests of high-speed current collection during which a public demonstra-

General Electric Company Schenectady, N. Y. Sales Offices in all Large Cities

GENERAL

ENGINEERING DEVELOPMENTS in 1923

By John Liston
General Electric Company

THROUGHOUT the electrical industry the year 1923 was characterized by a record volume of production in practically all classes of apparatus, exceeding in many cases the maxima of war-time output. The demand for electrical apparatus showed seasonal irregularities but manufacture proceeded almost uniformly at a high rate.

High-pressure production is not usually conducive to radical changes in design, and a considerable proportion of the improvements made were along conventional lines. There were, however, a number of distinctly new developments which represented advances in the art, some of which were fully commercialized while others were still being tested experimentally at the close of the year.

The recent tendency toward increased unit capacity continued in evidence. The 62,500-kv-a. turbine-generator, the first of the two 65,000-kv-a. waterwheel generators, and a synchronous converter of record size were completed while various types of transformers exceeded the record unit ratings of previous years.

In transportation, electric propulsion was for the first time applied to large cargo craft for canal service and improvements were made in auxiliary ship equipment. The more important railway developments occurred in foreign countries as in the preceding year and the high-voltage direct-current system was utilized to a large extent for main line steam railway electrification. In street railway service there was a further adoption of the economical light-weight double-truck car.

The use of automatic stations was extended to new industrial fields and initial foreign installations were made. Few radical changes occurred in either the design or construction, but the number installed and their unit capacity were greatly increased.

For radio service new tubes were developed of both higher and lower power than any previously produced and all sizes were improved in efficiency by the use of a new filament which gives high electron emission with low current consumption. Interesting and potentially important experiments were carried on with vacuum tubes for purposes other than communication, and carrier current telephone systems of increased range and power were used successfully on several power lines.

Investigations in high-potential phenomena were continued with the lightning generator, high-voltage direct-current testing sets and X-ray tubes of great power were developed, the photo-electric cell was practically applied in the operation of a commercial machine and a complete new line of electrically operated flow meters was standardized.

Higher efficiencies were achieved in the design of several types of industrial motors as compared with previous practice, and corresponding advances were made in the control apparatus to be used with them. The vast number of motor applications in modern industrial plants renders every detail improvement secured in the operation of individual motors of great potential economic value when considered in the aggregate.

Turbines

Developments during the year on large turbines consisted of refinement in mechanical details without radical changes in the construction. The outstanding features were the production of turbines for high steam conditions and the production of turbines in unprecedented volume.

Shipments for 1923, exclusive of turbines for mechanical drive and ship propulsion, had a total capacity of approximately 1,660,000 kw. This was an increase of 85 per cent over the average for the preceding five years and an increase of 32 per cent over the maximum war time production in 1917.

The first of the 35,000-kw. turbines designed for 550 pounds pressure and 750 deg. F. total steam temperature was completed and shipped while four of the same capacity and one 60,000-kw. compound unit to operate under similar steam conditions were under construction. It is confidently expected that the installation of these units will result in a substantial reduction in operating costs as compared with previous practice.

The solution of the problem of lower operating costs is being approached in two other ways. The first commercial equipment, which includes a mercury boiler and turbine exhausting into a condenser boiler which in turn generates steam for an existing steam turbine station was put in service in the fall of 1923. The results which have been obtained confirm experimental tests and there is every reason to believe that this development will be of great value in reconstructing many existing stations.

In addition to this there were under construction one 2600-kw. and one 4000-kw. turbine designed for a steam pressure of 1000 to 1200 pounds and to exhaust into

GENERAL ELECTRIC

Vol. 83, *No.* 26 New York, June 28, 1924 *Pages* 1315-1362

EARL E. WHITEHORNE
Commercial Editor
L. W. W. MORROW
Associate Editor
ROBERT M. DAVIS
Statistical Editor
T. P. KINDIG
Assistant Editor
R. L. SHEPHERD
Assistant Editor
EUSTACE C. SOARES
Assistant Editor

Electrical World

W. H. ONKEN, JR., and HAROLD V. BOZELL, *Editors*

ALLEN M. PERRY
Western Editor
Old Colony Bldg., Chicago
H. S. KNOWLTON
New England Editor
88 Tremont St., Boston
WALTER C. HESTON
Pacific Coast Editor
883 Mission St., San Francisco
H. C. ANDERSON
Assistant Editor
Old Colony Bldg., Chicago
PAUL WOOTON
Washington Correspondent
Colorado Bldg., Washington

CONTENTS

Editorials 1315

Progress Being Made in the Electrification of Cement Mills in the United States 1318

A 7,300-Kva. Automatic Hydro Station 1319
BY L. A. WHITSIT.
In Part I of an article on the Sprite Creek development of the Adirondack Power & Light Company the design details are described.

Appraisals Based on a Number of Meters Connected ... 1322
BY REUBEN B. SLEIGHT.

Actual Costs of Transmission Line and Substation 1324
Comprehensive data and details of a recently completed 132-kv. system in the Middle West are given.

Electrical Power in the Savoie 1327

Business Activity Slightly Below Normal During May . 1328

Floodlighting Railroad Yards 1329
BY E. G. MCALLISTER.
The author tells how floodlighting has increased operating efficiency and safety and gives costs and operating results.

Letters from Our Readers 1333

Departments

Central Station and Industrial Practice 1334
Central Station Business 1339
Digest of Electrical Literature 1342
News of the Industry 1344
Men of the Industry 1352
Court Decisions and Commission Rulings 1354
Manufacturing and Markets 1355
Business Conditions 1356
Activities of the Trade 1358
New Equipment Available 1359
Construction News 1360
Electrical Patents 1362

McGRAW-HILL COMPANY, INC.
Tenth Ave. at 36th St., NEW YORK

WASHINGTON, Colorado Building
CHICAGO, Old Colony Building
PHILADELPHIA, Real Estate Trust Building
CLEVELAND, Leader-News Building
ST. LOUIS, Star Building
SAN FRANCISCO, 883 Mission Street
LONDON, 6 Bouverie Street, London, E. C. 4

JAMES H. MCGRAW, President
ARTHUR J. BALDWIN, Vice-President
MALCOLM MUIR, Vice-President
E. J. MEHREN, Vice-President
MASON BRITTON, Vice-President
JAMES H. MCGRAW, JR., V.-Pres. and Treas.
C. H. THOMPSON, Secretary

Publishers of
Engineering News-Record — American Machinist
Power — Chemical and Metallurgical Engineering
Coal Age — Engineering and Mining Journal Press
Ingeniería Internacional
Bus Transportation — Electric Railway Journal
Electrical World — Electrical Merchandising
Journal of Electricity
(*Published in San Francisco*)
Industrial Engineer — Electrical Retailing
(*Published in Chicago*) (*Published in Chicago*)
American Machinist—European Edition
(*Published in London*)

Cable Address "Machinist, N. Y."
The annual subscription rate is $5 in the United States, Canada, Mexico, Alaska, Hawaii, Philippines, Porto Rico, Canal Zone, Honduras, Cuba, Nicaragua, Peru, Colombia, Bolivia, Dominican Republic, Panama, El Salvador, Argentina, Brazil, Spain, Uruguay, Costa Rica, Ecuador, Guatemala, and Paraguay. Extra foreign postage, $4 (total $9 or 38 shillings). Subscriptions may be sent to the New York office or to the London office. Single copies, postage prepaid to any part of the world, 25 cents.
Change of Address — When change of address is ordered the *new* and the *old* address must be given. Notice must be received at least ten days before the change takes place.

Copyright 1924
By McGraw-Hill Company, Inc.

Published weekly
Entered as second-class matter Jan. 20, 1907, at the Post Office at New York, N. Y., under the Act of March 3, 1879.
Printed in U. S. A.
Circulation of this issue 19,850

Member Audit Bureau of Circulations
Member Associated Business Papers, Inc.

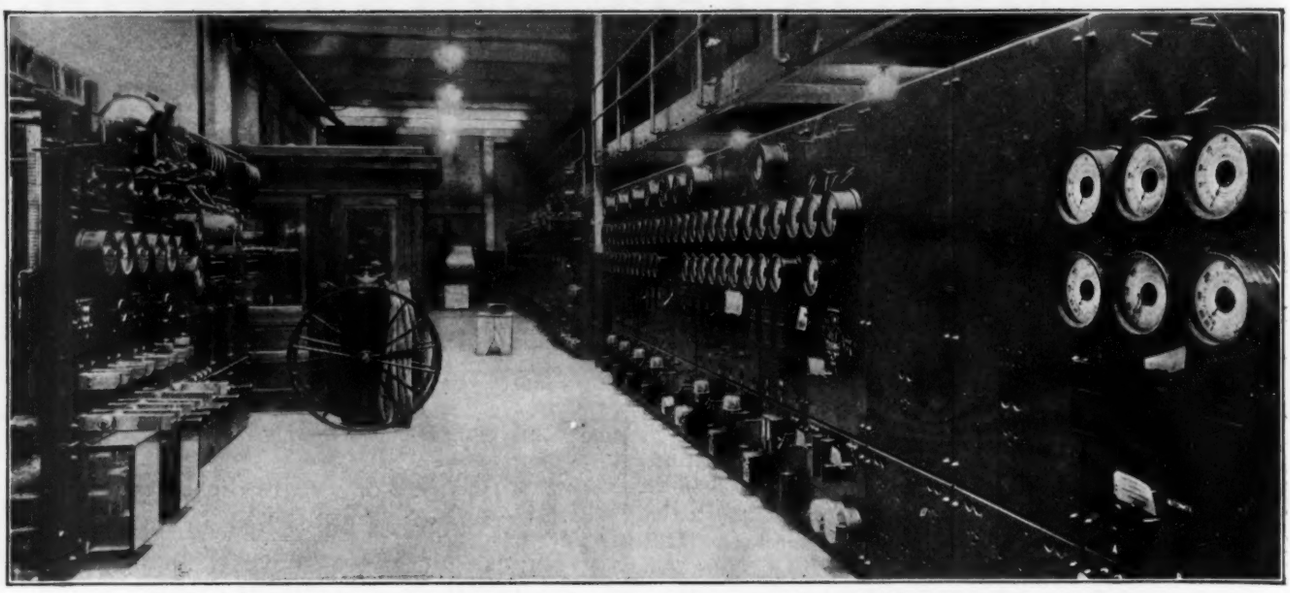
The Index— What It's For

FOR forty-one years the ELECTRICAL WORLD has published an index. It comes out twice a year, being thus available for the half-yearly bound volume. Although this is a perfectly natural and perfunctory part of publication, there is nevertheless a very practical value to the index that should appeal to every reader.

It is inevitable in the rush of modern living that few men should be able to accomplish all the reading they desire and plan to do. No matter how earnestly one may strive to absorb the news and writing of his industry, many pertinent and appealing articles must be laid aside for later attention. Too often they become buried. They are not dead, however, though without an index they would be. With an index they remain alive, ready for resurrection, accessible whenever time comes for extra reading. The index lists all this invaluable information and experience in good order for reference.

Study the index appearing in this issue, which, as usual, is furnished to every reader. Bound in the last number of the volume, it is as convenient for use with back issues stacked on the shelf as with bound volumes. The more it is used, the more its value will become apparent.

Advertising Index—Alphabetical, 82; Classified, 76, 78, 80; Directory of Engineers, 36, 37; Searchlight, 38-47



Foamite *equipment safeguards the plant of the Consolidated Gas, Electric Light & Power Co. of Baltimore against fire of any kind. Note the* Foamite *40-gallon engine on wheels, in left center above.*

It protects their service as well as their plant

Because Foamite *equipment instantly smothers any fire before it can spread*

UNCONTROLLED fire! It may hold up power plant service for hours—days. It costs the electrical industry millions every year.

How do these fires gain headway?

Not because engineers fail to safeguard against *electrical* fires. But because they overlook other serious hazards like oil, gasoline, grease and paint.

These quick-burning substances can not be put out with floods of water or liquid chemicals. They must be *smothered* out. The air must be cut off.

That is why more and more power plants are installing *Foamite* Protection. No fire can live an instant under the blanket of Firefoam thrown out by *Foamite* equipment. Firefoam coats and clings to any burning object—floats on any liquid—defies fierce heat and drafts—completely stifles the fire at the very start.

Hundreds of plants large and small in every industry have this sure protection today. It is saving property and life everywhere. It offers you the most certain security against fire damage ever known.

You can get *Foamite* equipment in a form suitable for any type or size of fire risk. A *Foamite* hand extinguisher will instantly kill an incipient fire of any kind. The *Foamite* engine on wheels quickly puts out larger blazes. Or you can safeguard your plant with a complete *Foamite* System installation.

* * *

Our fire protection specialists at 300 convenient centers are ready to prescribe the type of *Foamite* equipment best adapted to your particular fire risks. They can also supply the *Fire-Gun*, highest development of the carbon-tetrachloride method of extinguishing fire in live electrical equipment of high voltage.

Write for free illustrated literature describing Foamite-Childs fire protection in detail.

FOAMITE-CHILDS CORPORATION
Fire Protection Engineers and Manufacturers
112 Turner St., Utica, N. Y.
Canadian Address: Foamite-Childs of Canada, Ltd., Toronto, Ont.

Foamite-Childs Protection

Short Story of a Big Achievement—

THE story of a machine which saves money. For all plants—small, medium, and large. A simple machine. A reliable machine. An efficient machine. One which reduces operating and production worries.

SIMPLICITY—the true test of a designer's ability. A machine that is simple is also easy to operate. Experienced labor is not required. There are no complicated mechanisms. Interruptions in production schedules are avoided.

(*Continued in the next issue.*)

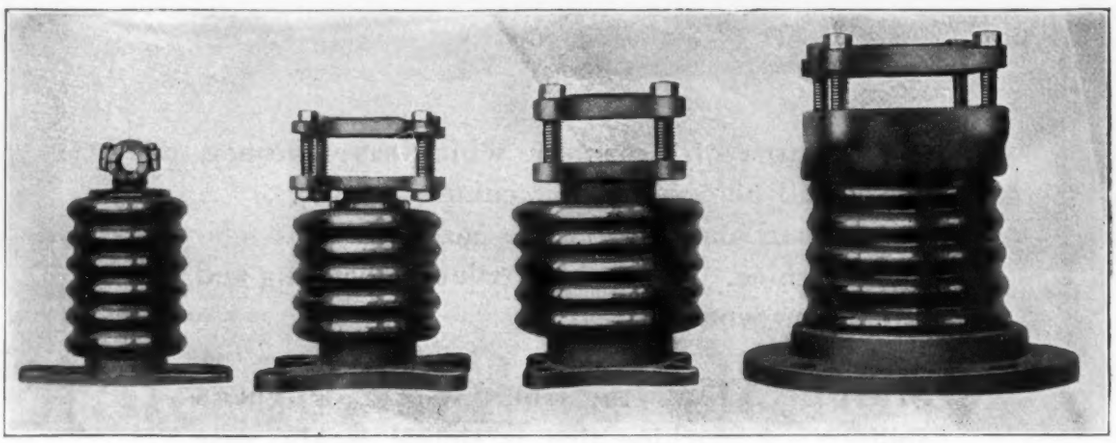
INGERSOLL-RAND COMPANY-11 BROADWAY. NEW YORK CITY.
Offices in all principal domestic and foreign cities.

Ingersoll-Rand

HIGH TENSION EQUIPMENT

UNIT TYPE UNIT TYPE UNIT TYPE UNIT TYPE UNIT TYPE

BUS SUPPORTS FOR EVERY SERVICE



Diameter 3¾ inches | Diameter 4¾ inches | Diameter 6 inches | Diameter 6½ inches

ADVERTISING MADE HIM FORGET

A FEW days ago a well known public utility engineer was at our factory inspecting some 132,000 volt equipment being built for his company. He seemed surprised at our large volume of bus support business—in fact, had the impression that we did not particularly care for this class of business.

THIS was somewhat of a shock to us, so we asked him point blank where he got such an idea. It developed he is a close reader of Electrical World advertising and the large amount of space we devote to outdoor equipment had created this impression.

AS a gentle reminder to others who may, also, have forgotten, we illustrate above just a few of our indoor bus supports for standard heavy and extra heavy duty.

WE have thousands of indoor supports, switches, and other combinations—so if you, also, have been too much influenced by our outdoor equipment advertising—give us an opportunity to quote on your requirements—we can give you Unit Type throughout. Our opportunity will be yours.

We know our Bulletins will interest you. Why not send for them—today?

DELTA-STAR ELECTRIC CO., 2400 Block, Fulton Street, Chicago, Ill.

Manufacturers of High Tension Equipment

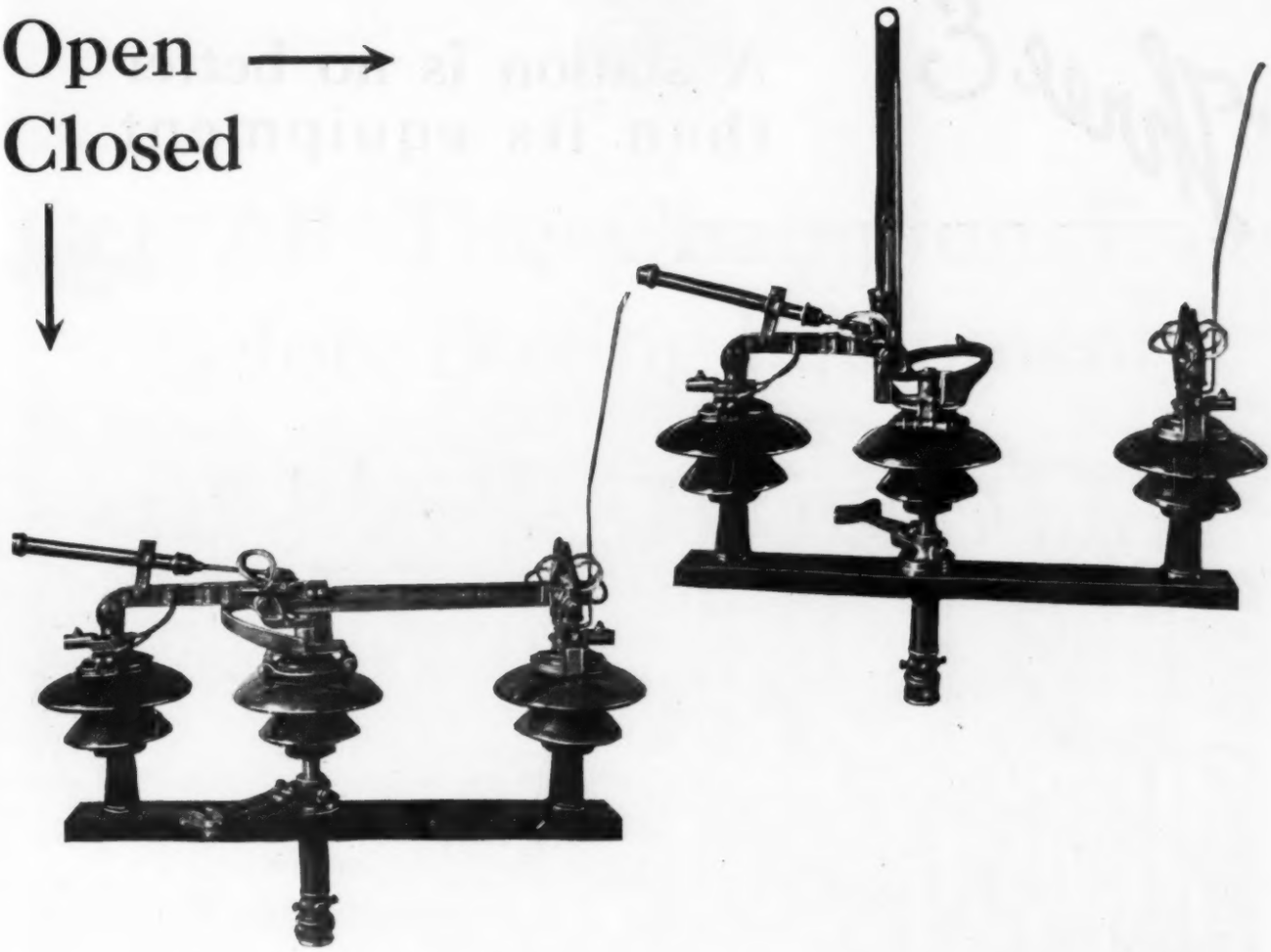
Birmingham, Ala., 827-830 Brown-Marx Bldg.
Boston, Mass., 294 Washington St.
Buffalo, N. Y., 595 Ellicott Square
Charleston, W. Va., The Eng'g Service Co.
Columbus, Ohio, 600 Joyce Realty Bldg.
Detroit, Mich., 708 Ford Bldg.
Indianapolis, 518 Trac. Term. Bldg.
Kansas City, Mo., 301-2 Dwight Bldg.
Knoxville, Tenn., Holston Nat'l Bank Bldg.
Los Angeles, Calif., 212 I. W. Hellman Bldg.
Minneapolis, Minn., 940 Security Bldg.
New York, N. Y., 25 Broad St.
Orlando, Fla., Cornell-Mathews Co.
Philadelphia, Pa., 1333 Real Estate Trust
Pittsburgh, Pa., 934 Union Trust Bldg.
Rochester, N. Y., 119 Main St., E.
San Francisco, Calif., 193 Second St.
Syracuse, N. Y., City Bank Bldg.
St. Louis, Mo., Railway Exchange
Salt Lake, Utah, 313 Dooly Bldg.
Seattle, Wash., Hoge Bldg.
Toronto, Ont., 213-219 Sterling Road
A/S Kraftoverforing, Kristiania
Allenwest, S. A., Ltd., City House, Johannesburg, So. Africa
Berthon & Touzot, 40 Rue d'Aguisseau, Boulogne-sur-Seine, France
Carrick, Wedderspoon, Ltd., Christchurch, New Zealand
Allied Engineering, Ltd., Sidney, Australia

DELTA-STAR

The Standard of Comparison

UNIT TYPE INTERCHANGEABLE PARTS

Open →
Closed
↓



Heavy Duty Quick Acting Air Break Switch

Quick Opening
Quick Closing
Built to be Slammed Closed
Self Aligning
Adjustable Contacts
Contracts Ground to Fit
All Blades Make Full Stroke
Very Rugged
All Brass and Bronze Parts

T. F. JOHNSON, JR.

P. O. Box 359
Atlanta, Ga.

Distributors—The Memco Engineering & Mfg. Co., 381 Hamilton St., Long Island City, N. Y. Harry G. Holabird, 451 East 3rd St., Los Angeles, Calif. J. H. Albrecht Co., 711 Empire Building, Pittsburgh, Pa.

To T. F. JOHNSON, JR.,
P. O. Box 359, Atlanta, Georgia

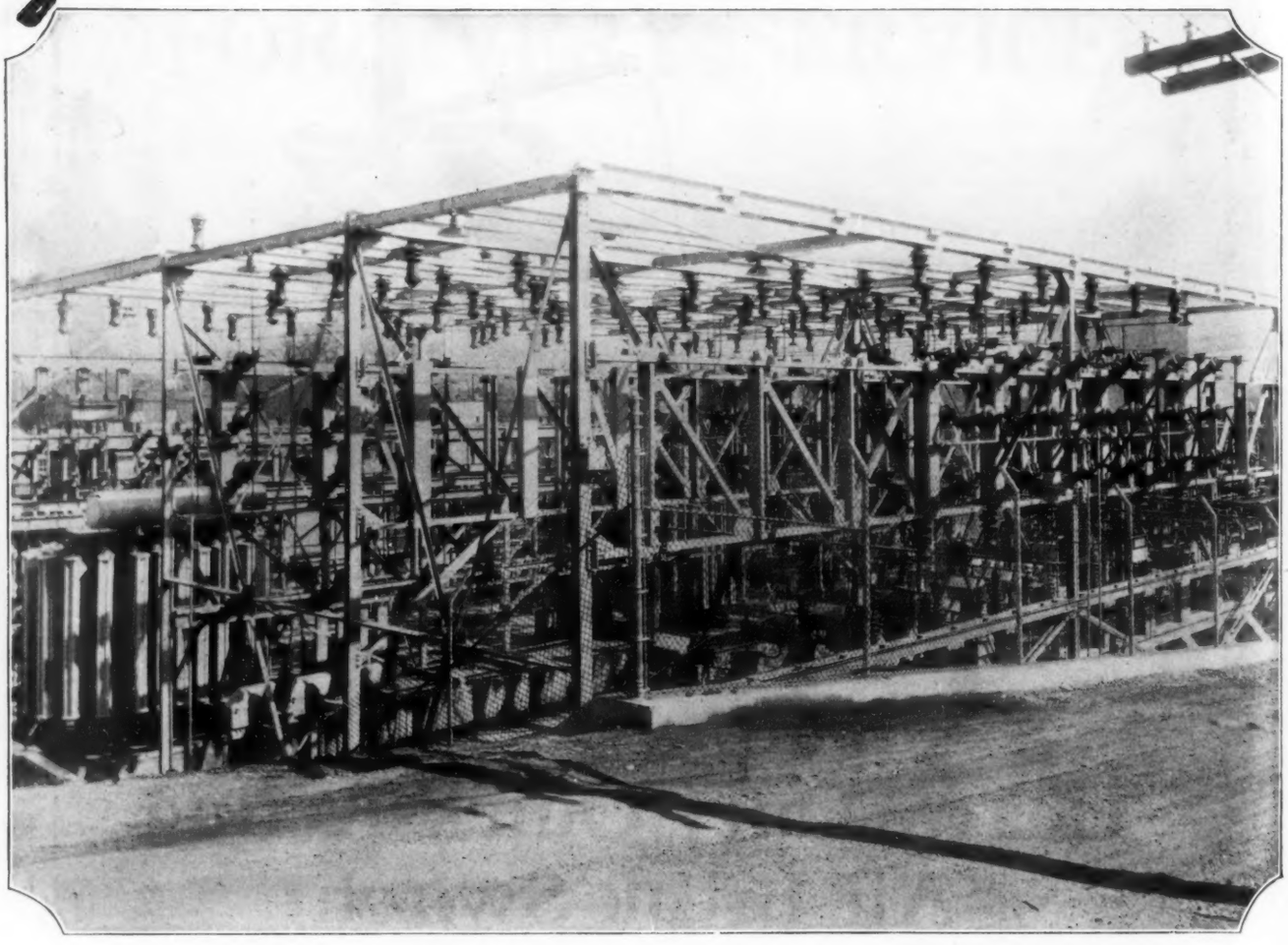
Please send full details and prices on the Johnson Heavy Duty Quick Acting Air Break Switch.

Name ..... Position .....

Company ..... City ..... State .....

"Three E"

A station is no better than its equipment



The units that make up a station are like links in a chain. One weak link cannot hold up with the other strong ones. It gives way under strain. We make the equipment that makes the station of greatest service worth. It's the individual durability of each piece of "Three E" Equipment, the simple yet effective structure, and our comprehensive designing ability, that together makes a station worthy of your investment and insures that investment. That a station can be of greatest service worth with "Three E" Equipment should be of primary importance to you—building a station is merely a secondary consideration.

"Three E" Equipment is "made for the user's best advantage" and with that thought a foremost consideration, we develop our equipment to be of greatest "Service Value."

"Service Value" — Low cost per year of service.

Electrical Engineers Equipment Co.
General Offices: 710 W. Madison St., Chicago, Ill.
Sales Offices in all principal cities
Eastern Offices: 21 Park Row, N. Y.
Canadian Representative:
Northern Electric Company
LIMITED

"THREE E"
HIGH QUALITY
LINE AND STATION EQUIPMENT

ELECTRICAL ENGINEERS EQUIPMENT CO. THREE E CHICAGO, U.S.A.

Let us send you our monthly bulletins, also announcements, from time to time, of new "Three E" Equipment. Write today.

Get All The Champion Facts Before Buying Equipment

Before committing yourself on high tension equipment it will be to your best interest to familiarize yourself with Champion service.

Designers of Champion indoor and outdoor switches, bus supports and choke coils have perfected very definite improvements over prevailing practices.

Not the least of these is a very consistent principle of interchangeability running through the entire Champion line which gives you a decided advantage in uninterrupted service and cuts out the expense of stocking extra equipment.

There are also superiorities in material and workmanship effecting continuity, reliability and general efficiency, especially where duties are extra heavy.

Our only suggestion is that you give us an opportunity to inform you specifically on these Champion characteristics and permit us to present facts and figures covering your individual requirements.

Then we are quite content to leave decision to you.

THE CHAMPION SWITCH COMPANY
550 ABBOTT ROAD
Post Office Box 816—Buffalo, N.Y.

[A representative set of blue prints, covering Champion indoor and outdoor switches and bus supports will be sent on request.]

The CHAMPION SWITCH COMPANY

for the tendency toward

HIGHER VOLTAGES

The ***S&C Fuse*** consists of a fusible element held in tension by a spiral spring within a glass tube, which is filled with a non-inflammable liquid of extremely high dielectric strength.

The extremely Rapid and Positive Action of the ***S&C Fuse*** on short circuit provides a selective feature on branch circuits which positively clears the line before the main line fuse or oil circuit breaker has time to operate.

400 Ampere
25,000-Volt
S&C Fuse
(about one-half size)

Trade Name and Patents

The correct Trade Name is

"S&C Fuse"

but it has been referred to and described as "Carbon Tetrachloride," "Tetrachloride," "Pyrene," and "Chemical" Fuse. The Manufacture, Sale and Use is controlled by United States and Foreign Patents, granted and pending. The S&C Fuse is manufactured in the United States only by

Schweitzer & Conrad, Inc.
Chicago

Send for the Whole Story
BULLETIN 200
Ready for Distribution

There is no substitute for the S&C Fuse

SCHWEITZER S&C CONRAD, INC.

4435 RAVENSWOOD AVENUE CHICAGO, ILLINOIS U.S.A.

New York	Buffalo	Birmingham	Kansas City	Los Angeles	Toronto
Boston	Pittsburgh	St. Louis	Omaha	San Francisco	Montreal
Philadelphia	Cleveland	Youngstown	Dallas	Vancouver	Winnipeg

Is Power Lost Through Insulator Leakage?

What the leakage of one watt per insulator means in dollars to the power companies of the country.

Extracts from "Insulator Testing Methods and Devices" by Lloyd A. Wildman in American Gas & Electric Company Bulletin.

"Little thought has been given in the past years to *power loss through insulator leakage*, but it has been predicted that within a very short time, insulator leakage will be a big factor for consideration in building and maintaining an efficient transmission system."

"Laboratory experiments indicate that an insulator (made of inefficient porcelain) may leak as high as one hundred watts without interrupting the service."

"Records show that there are about twenty-five million insulators in service in the United States." (Calculate your possible loss.)

Locke Porcelain Does Not Leak

The resistance to leakage of Locke Insulators is due to the composition of the porcelain. Locke Porcelain will not absorb moisture, and, therefore, it is impossible for current to leak through it. The non-absorbent quality of Locke Porcelain is not dependent upon the surface glaze. The glaze is put on to give the insulator a smooth surface and thereby prevent dust and dirt from collecting on it.

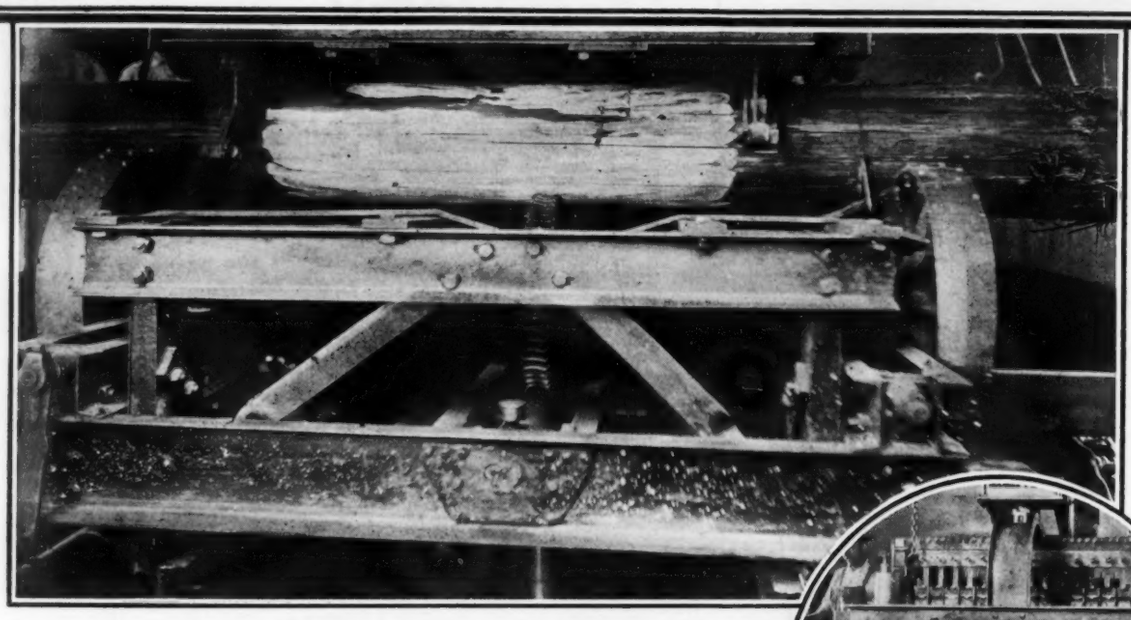
LOCKE INSULATOR CORPORATION
Baltimore, Md., and Victor, N. Y.

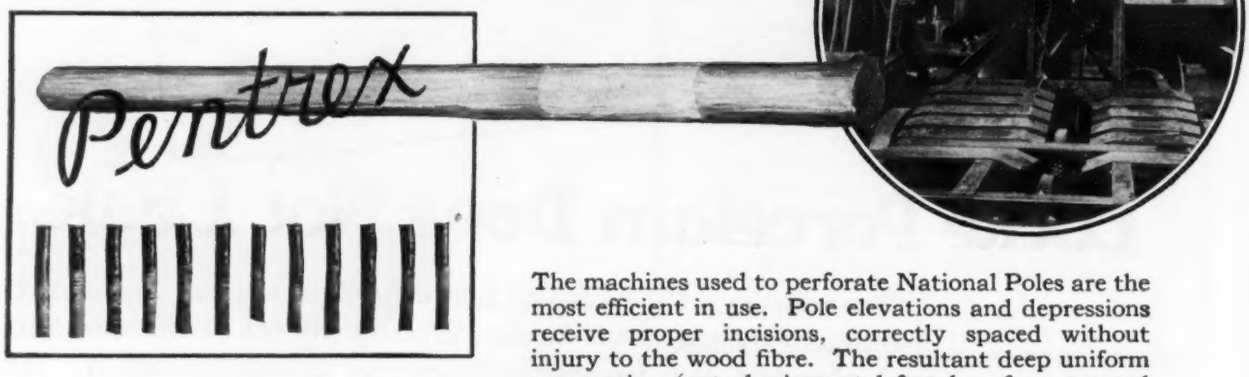
LOCKE
PORCELAIN

Western Red Cedar

Light, Durable and Strong Plain or Treated Poles

Northern White Cedar





The machines used to perforate National Poles are the most efficient in use. Pole elevations and depressions receive proper incisions, correctly spaced without injury to the wood fibre. The resultant deep uniform penetration (note borings at left taken from treated National Poles) in the sapwood completely protects the heartwood. This is the reason National Treated Poles are long-life poles.

NATIONAL POLE COMPANY

Escanaba, Michigan

Western Electric Company

Distributors:

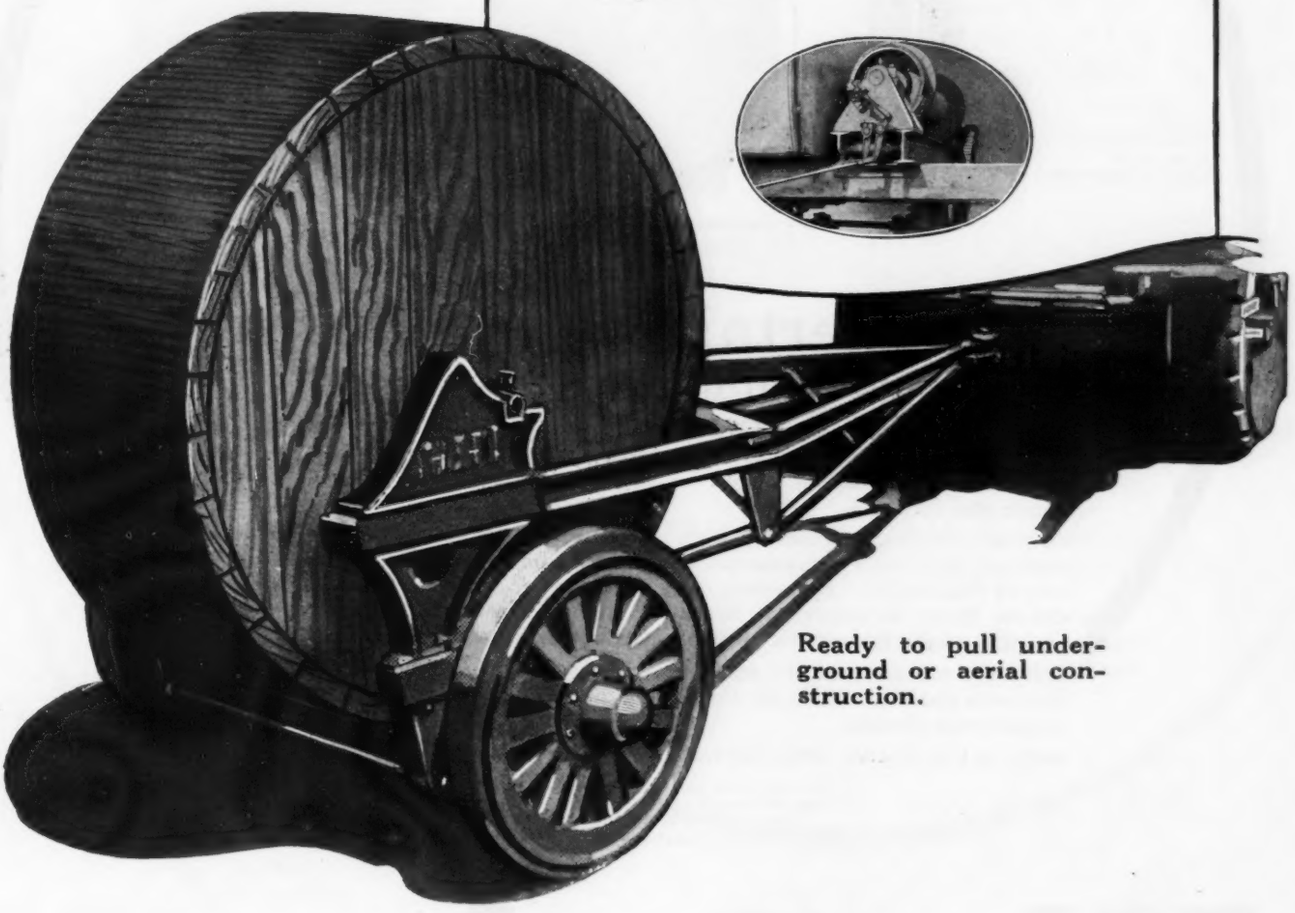
Offices in 47 principal cities

This Trailer puts you ahead

The Western Electric Cable Reel Trailer makes possible these economies.

—Saves unloading
—Saves jacking up and truing up
—Saves truck capacity
—Saves personal hazard
—Saves the cable

Look into the advantages of this manpower saving device. For full particulars write our nearest Distributing House or the Western Electric Company, 100 East 42nd St., New York City.



Ready to pull underground or aerial construction.

Western Electric

OFFICES IN FORTY-EIGHT PRINCIPAL CITIES

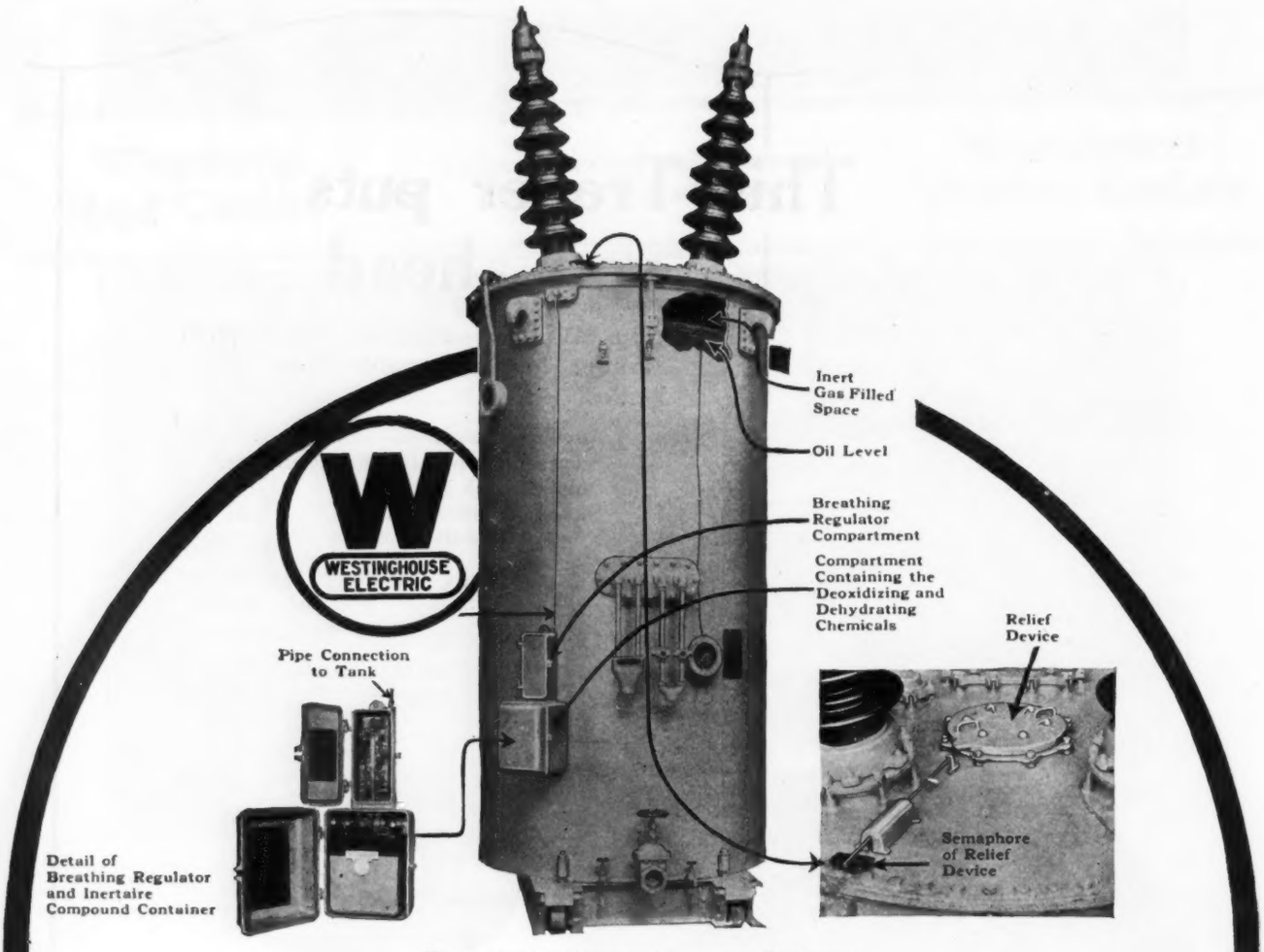


Fig. 1—Details of Inertaire Transformer Equipment.

The Inertaire Transformer

The latest development in transformer design

Sludging of transformer oil—due almost entirely to oxidation—is effectively prevented in the Inertaire Transformer. There are consequently no hot spots, and the oil and coils last longer. This is accomplished by a layer of nitrogen above the oil level.

Ordinary shocks, caused by high power arcs, are absorbed by the nitrogen cushion; and more extreme pressures are relieved by the rupture of a protective diaphragm. Secondary explosions cannot occur because gas formations cannot ignite in nitrogen. Moisture cannot enter to reduce the dielectric strength of the oil and the oil itself does not deteriorate.

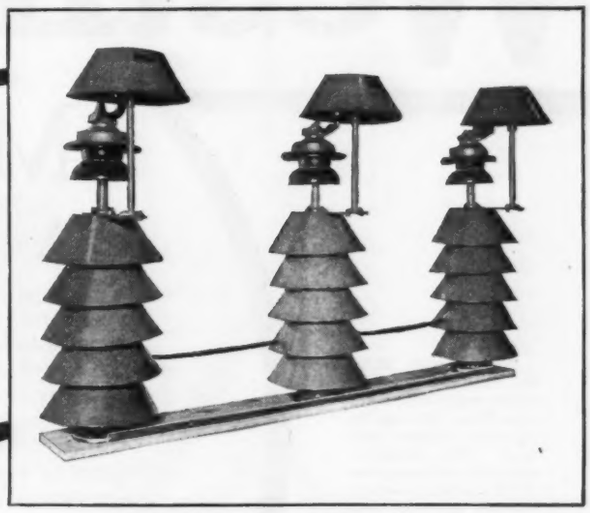
Increased transformer life, and a positive assurance against explosions, is to be had with the Westinghouse Inertaire Transformer—the latest development in transformer design.

Refer to our district office for leaflet 20182.

Westinghouse Electric & Manufacturing Company
East Pittsburgh Pennsylvania
Sales Offices in All Principal Cities of the
United States and Foreign Countries

Westinghouse

A Complete Line Of Valve Type Arresters

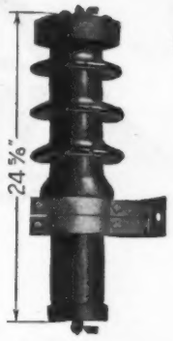


A 25,000 Volt, 3-Phase, Outdoor
SV Autovalve Station Arrester

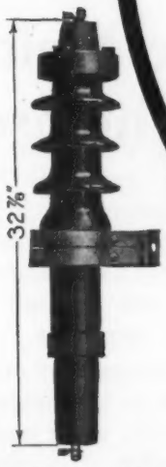
2500 Volt
LV Arrester

7500 Volt
LV Arrester

15,000 Volt
LV Arrester



25,000 Volt
LV Arrester



37,000 Volt
LV Arrester

The "Autovalve" is the first arrester operating on the "Valve Principle" to cover the entire alternating-current field. There are no liquids to freeze, no chemicals to deteriorate, and no film to change. It operates like a simple spark gap, in the form of a "glow discharge" across an air gap.

The SV is a station arrester for the protection of generating stations and substations.

The LV is a line arrester and is now available for 2,500 to 37,000 volts.

The small-space factor and mechanical advantages are important features in the popularity of this line of arresters.

Leaflet 20013-A describes the Line Arresters.
Leaflet 20149 describes the Station Arresters.

Westinghouse Electric and Manufacturing Company
East Pittsburgh Pennsylvania
Sales Offices in All Principal Cities of the United States and Foreign Countries

Westinghouse

Westinghouse

© 1923 by W. E. & M. CO.

Melting Pots
Assure 100% Control

Electrically-heated melting pots are establishing new standards everywhere. They overcome the worst fault of the gas-heated pot—the impossibility of maintaining uniform pouring temperatures.

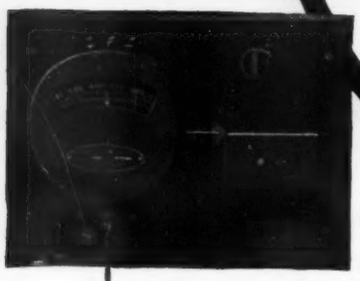
With the advent of the Westinghouse Melting Pot has come the exact, automatic temperature control so necessary today. *Tests* have shown how important a factor this is. *Actual factory practice* has demonstrated how effectively quality is kept up and how costs are kept down *by having pouring temperatures right at all times.*

This applies to solder, babbitt, lead, zinc and other soft metals and alloys. Particularly is this true of lead-base babbitt, the quality of which can be kept so uniformly high, that in many places its use is replacing that of the *much more expensive* tin-base babbitt.

You'll find that Westinghouse Melting Pots quickly pay for themselves.

WESTINGHOUSE ELECTRIC & MANUFACTURING CO
EAST PITTSBURGH, PA.
Sales Offices in All Principal Cities of the United States and Foreign Countries

Westinghouse Melting Pots are made in 150 lb. and 750 lb. metal capacities. They can be located anywhere in the shop. They occupy a minimum of floor space. Thick insulation assures low-cost operation and a cool working pot.



Westinghouse Melting Pots Pay for Themselves

Westinghouse Melting Pots usually pay for themselves through economies they introduce. They improve quality, reduce wastage, reduce labor charges—all the result of maintaining correct pouring temperatures with the aid of Westinghouse automatic control apparatus.

Whether for motor bearings or for other industrial purposes, metals heated in Westinghouse Melting Pots assure longer service, more continuous production, and greater profits.

Write for Leaflet 1868

More Effective Lighting

With Sol-Lux, your installation costs are lowered. The drop canopy, an exclusive Sol-Lux feature, enables your electrician to hang more quickly the luminaire, thus saving time and expense.

Sol-Lux illumination means more effective lighting for your buildings at the ordinary cost of current.

Your maintenance costs are cut; cleaning Sol-Lux is merely wiping the outside of the globe—the inside is practically dustproof—and re-lamping without removing the globe saves time and decreases breakage.

Add to these advantages the fact that Sol-Lux can be readily adapted to meet every possible interior lighting need and you know why your buildings should have Sol-Lux illumination.

To learn more about Sol-Lux, ask the nearest Westinghouse office, today.

Westinghouse Electric & Manufacturing Company
George Cutter Works South Bend, Indiana
Sales Offices in All Principal Cities of the
United States and Foreign Countries

Westinghouse

The old

and the new

It pays the lighting company to sell the city better street lighting

THE public forms its opinion of the service rendered by the Central Station very largely from the street lighting which the Central Station gives the public.

There is illustrated above the "Before and After" effect in the street lighting of East Cleveland. The great improvement made in this installation as evidenced in the photographs was accomplished by the use of Holophane street lighting refractors. Picture for yourself the favorable influence this change exerted on public opinion.

Holophane prismatic street lighting refractors are recognized everywhere as the most efficient means for obtaining effective street illumination. At the right is illustrated one of our many types of refractors.

HOLOPHANE GLASS COMPANY

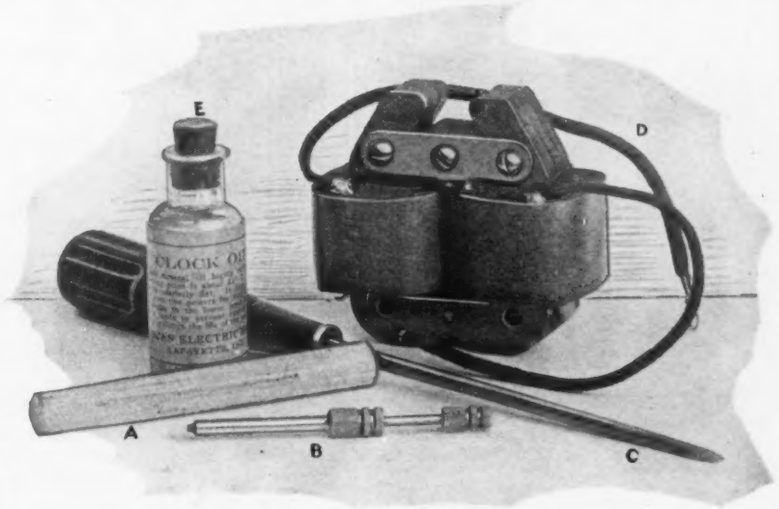
340 Madison Avenue, N. Y. C. *Works*—Newark, Ohio

In Canada—146 King Street, W., Toronto

HOLOPHANE

DIRECTS LIGHT SCIENTIFICALLY

Holophane Dome Refractor with General Electric pendant fixture



This is the fourteenth of a series of talks on Duncan meters, and emphasizes the fact that

DUNCAN design reduces meter maintenance to its simplest elements

Illustrated above is the entire equipment required by the meter maintenance man in doing all the work necessary to keep Duncan meters in excellent working condition (short of sending them back to the factory for calibration or major repairs). Any adjustment light or heavy load phase or power factor, as well as the complete dismounting of the grid or removing of any of the coils, can be done with an ordinary screwdriver. (C)

When the jewel post is taken out for inspection or cleaning, every two or three years, the pivot, being very inexpensive, is usually replaced. The old pivot is easily withdrawn and the new one inserted by means of the pivot puller (B).

We have always advocated careful cleaning of the bearings and for this we provide clean, dry corn pith (A). Its use facilitates also the removal of dust from gear teeth and similar places of small clearance.

Duncan oil (E) is a pure mineral oil highly refined and chemically stable. Its freezing point is about 25 deg. F. below zero and its viscosity curve is relatively flat. It does not become rancid and retains its protective powers for long periods of time. It is especially valuable in the lower jewel bearing of watthour meters, where it tends to prevent rusting of the steel pivot and thus greatly prolongs the life of the jewel.

The separable potential electro-magnet coils (D) make possible replacements of burned coils (usually only one is affected) at the moderate cost of thirty cents.

Making maintenance easy insures its being done. The small outfit shown is indicative of the small amount of maintenance required by Duncan meters, which is eloquent of the lasting qualities of Duncan engineering and construction.

DUNCAN ELECTRIC MANUFACTURING CO.
LAFAYETTE, IND.

BRASS AND BRONZE PRODUCTS

Brass and Bronze Sheets
Brass and Bronze Round Wire
Brass and Bronze Flat and Square Wire

COPPER PRODUCTS

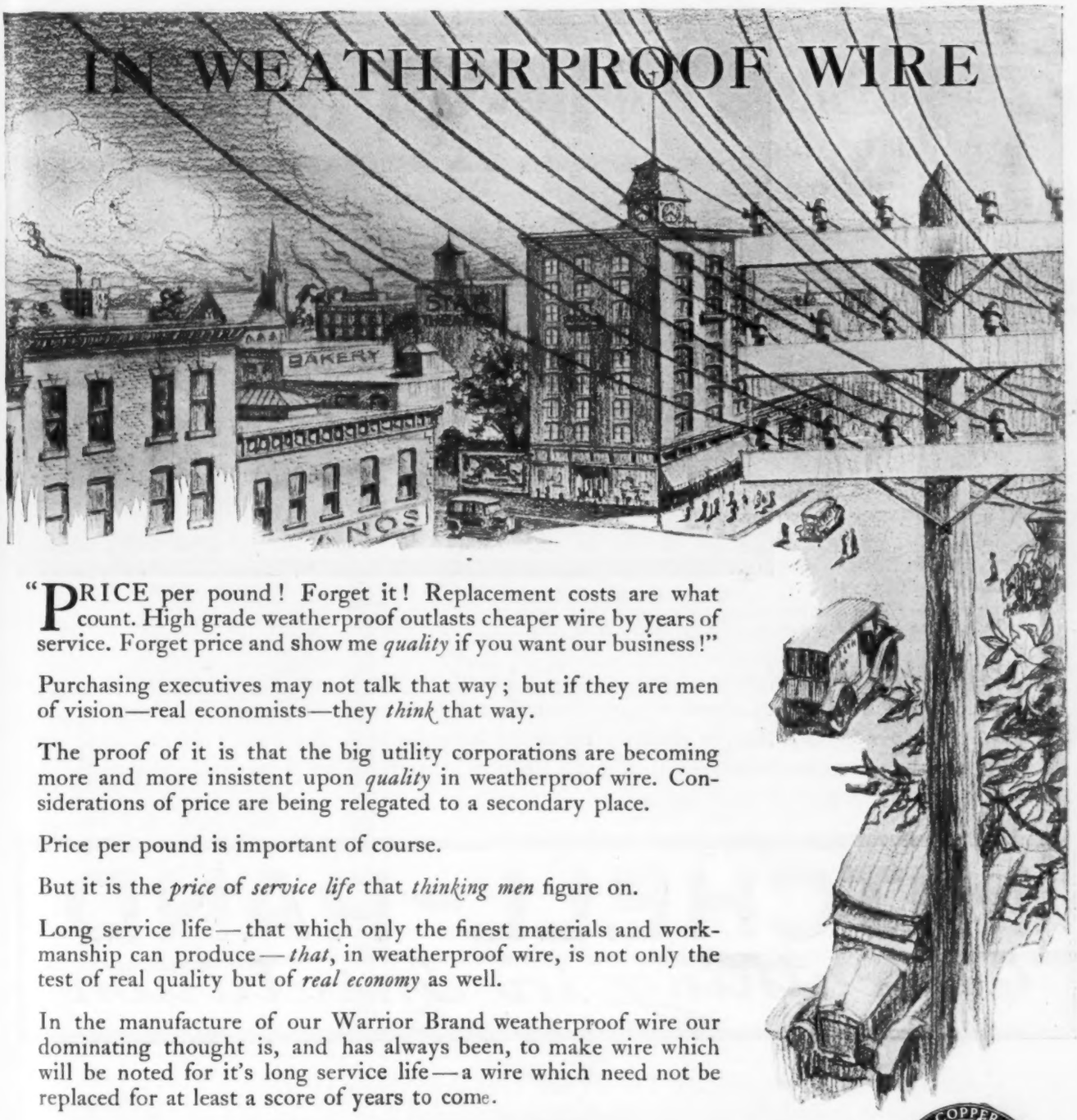
Round Bare Wire
Bare Strand
Trolley Wire—Round and Shaped
Flat and Square Bare Wire
Tinned Wire and Strand
Weatherproof Wire and Strand
Slow-burning Wire and Strand
Bus Bars
Copper in Rolls
Rolled Rods
Drawn Rods—Round, Square and Rectangular

AMERICAN COPPER PRODUCTS CORPORATION

WARRIOR-BRAND
Weatherproof Wire
Mills, Bayway, N. J.

AMERICAN COPPER PRODUCTS CORPORATION
233 BROADWAY NEW YORK

IN WEATHERPROOF WIRE



"PRICE per pound! Forget it! Replacement costs are what count. High grade weatherproof outlasts cheaper wire by years of service. Forget price and show me *quality* if you want our business!"

Purchasing executives may not talk that way; but if they are men of vision—real economists—they *think* that way.

The proof of it is that the big utility corporations are becoming more and more insistent upon *quality* in weatherproof wire. Considerations of price are being relegated to a secondary place.

Price per pound is important of course.

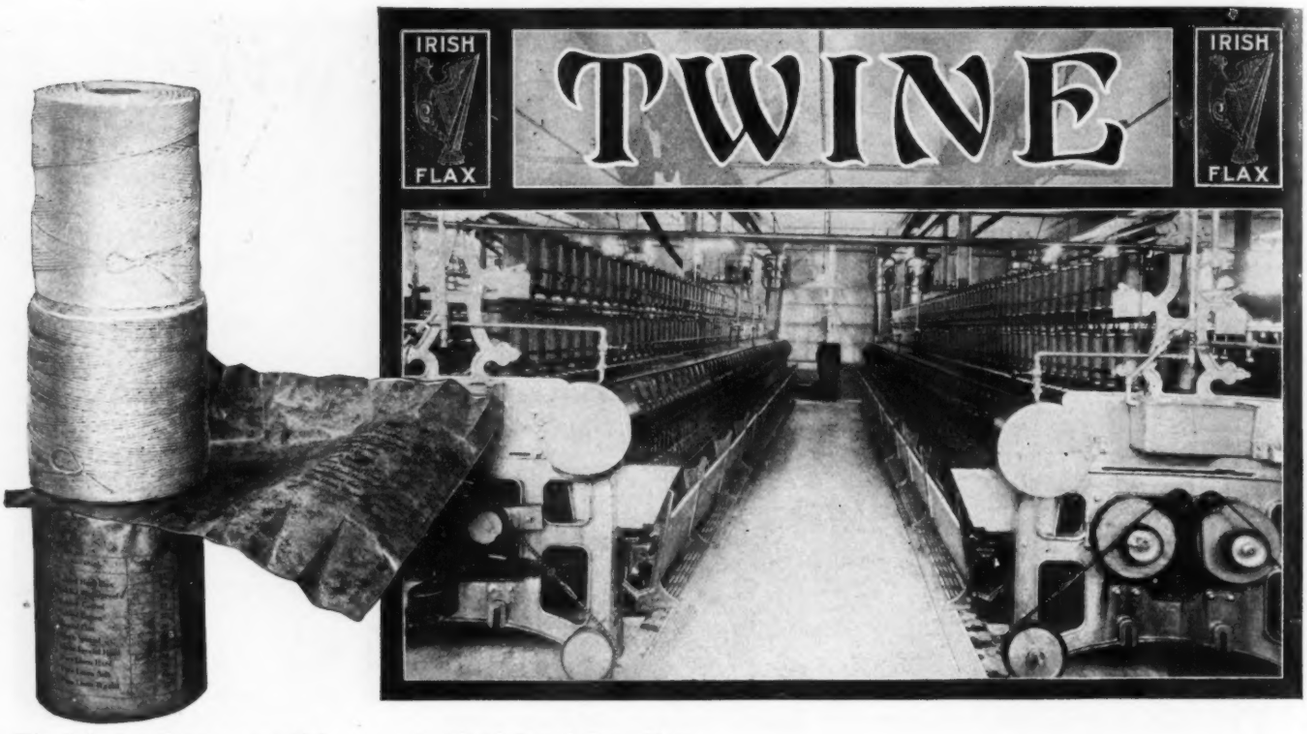
But it is the *price* of *service life* that *thinking men* figure on.

Long service life—that which only the finest materials and workmanship can produce—*that*, in weatherproof wire, is not only the test of real quality but of *real economy* as well.

In the manufacture of our Warrior Brand weatherproof wire our dominating thought is, and has always been, to make wire which will be noted for it's long service life—a wire which need not be replaced for at least a score of years to come.

WARRIOR-BRAND
Weatherproof Wire
Mills, Bayway, N. J.

AMERICAN COPPER PRODUCTS CORPORATION
233 BROADWAY NEW YORK



The Spinning Frames on which are made Shield Brand Pure Linen Armature Twines—every fibre guaranteed genuine Irish Flax.

"Linen" is not descriptive of twine quality because some "linen" twines are weaker than good cotton. A slender pure linen thread has the same strength but *greater yardage per pound* than a cheaper twine of larger size. Barbour's Irish Flax makes the strongest twine—it may cost a little more per pound but on the basis of *strength and length* it is cheaper.

MITCHELL-RAND

"Everything in Insulation"

Cable Laid Cotton Armature Twines are used principally to cover leads because their bulk quickly fills a given space and their thickness prevents overlapping of successive turns. Whether cotton or linen, Shield Brand Twines possess the ultimate in quality.

Comparative Cost of Cotton and Linen Twines

Each Approx. 40 lbs. Tensile Strength

No. 21 Cable Laid Cotton, .063 in. diam., 900 ft. per lb.
$.90 per lb., or 10 ft. for 1c.

6 ply Ordinary "Linen," .025 in. diam., 4,000 ft. per lb.
$2.50 per lb., or 16 ft. for 1c.

3 ply Shield Brand, .017 in. diam., 6700 ft. per lb.
$3.25 per lb., or 20 ft. for 1c.

Send for sample card.

MITCHELL-RAND MFG. CO., 18 VESEY ST. NEW YORK, N. Y.

Dudlo Products
are greatly emphasized by a background of unusual institutional achievement

In the Dudlo plants have been developed wonderful improvements in manufacturing processes. The result of these advances in engineering achievement has been along the lines of quality products and standard quantity production. An institution has grown, winning a place of greatest importance in the Electrical Industry. A vast amount of anticipatory work was necessary to maintain a high standard of quality and to meet the requirements of every demand. Here is a complete manufacturing process, beginning with the copper rod, and making magnet wire and windings available for all commercial requirements.

A correct product to strict specifications is assured. Rigid inspection is unfailingly maintained. We invite any manufacturer having a magnet wire or coil problem to take advantage of our engineering service for which there is no obligation.

DUDLO PRODUCTS Bare and Tinned Copper Wire, Enameled, Cotton, Silk, Cotton Enameled, Silk Enameled, Magnet Wire.

Coil Windings for Ignition, Radio, Meter, Telephone, Transformers, X-Ray, Violet-Ray, Magnets and all electrical purposes.

Dudlo Manufacturing Corporation
Fort Wayne, Indiana

DUDLO *Magnet Wire and Windings*

TIREX NEVER KINKS

In a bleaching vat for 10 hours—

Unretouched photograph of the piece of Tirex that proved so good that it was put back in service after 10 hours in a bleaching vat.

An accident that proved the worth of Tirex

At a prominent New England bleachery a piece of TIREX Portable Cord and the lamp to which it was attached became lost in a kier of cloth and was boiled at 15 lbs. pressure for ten hours in a dilute alkaline solution. The liquor dissolved the cement between the base of the lamp and the globe. The key to the socket was boiled off. The wooden handle to which the socket was attached was boiled loose and free from the socket.

When the kier was opened and the cord was found the lamp base was unscrewed from the discolored socket and a new lamp inserted. The TIREX Cord was not damaged. The electrical foreman, much surprised, reported the facts to us. We pass them on to you.

Samples and prices of TIREX Cords and Cables will be sent on request.

SIMPLEX WIRE & CABLE Co

MANUFACTURERS

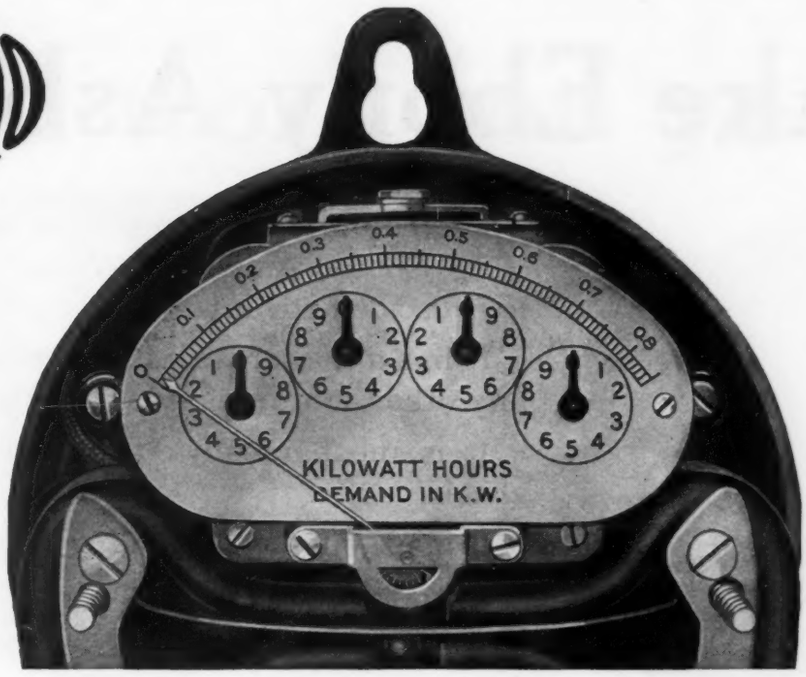
201 DEVONSHIRE ST., BOSTON 9

CHICAGO SAN FRANCISCO NEW YORK

TIREX

PORTABLE CORD

SANGAMO



Do not estimate maximum demand—*measure it*

It's the cheaper and the only equitable way

ESTIMATING a customer's probable maximum demand is hardly any fairer than estimating his probable monthly energy requirements and doing without watthour meters. Periodic estimates of customers' demands are expensive and inaccurate and do not permit of ready adjustment of rates if a customer's demand increases or decreases. The consumer is seldom satisfied with the rate he gets for he knows that the estimate of his demand is but little better than a mere guess. The only equitable basis for making demand charges is to determine accurately the *actual* maximum demand that has occurred between regular monthly meter readings.

This is exactly what the Sangamo Maximum-demand Register permits you to do. It combines in one unit a watthour register, a demand register and a timing device, indicating on a single dial the energy consumption and the maximum demand that has occurred since the last meter reading and resetting.

A high degree of accuracy is obtained in both energy and demand indications as the result of a number of features of which the following are the most important.

Very little torque is required to advance the demand-indicator hand thus placing practically no additional load on the rotating element of the meter.

Constant time intervals—a most important consideration—are insured through the use of a new tpye of motor which operates at a constant synchronous speed despite voltage, friction and temperature variations.

The use of synchronous motors for this purpose is a Sangamo development.

No slippage or inoperative periods of appreciable length exist as the drive is positive and the pusher arm is reset almost instantaneously through the release of a spring wound up by the synchronous motor.

You can readily obtain the benefits derived from monthly maximum-demand readings as any Sangamo Type-H Watthour Meter may be easily converted into a combined watthour and demand meter by replacing the standard register with the Sangamo Maximum-demand Register. *Write for details.*

Sangamo Electric Company

Springfield, Illinois

New York Chicago Birmingham San Francisco Los Angeles

SANGAMO METERS

FOR EVERY ELECTRICAL NEED

6020-1

Make Ebony Asbestos

AS a mounting for electrical apparatus, Ebony Asbestos Wood possesses four decided advantages:

It has a higher dielectric strength than any other commerical insulating base.

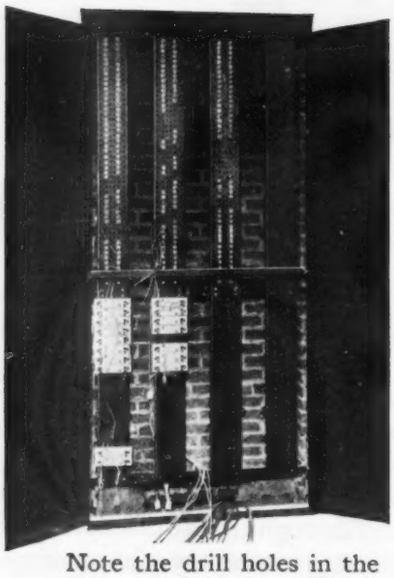
It is mechanically strong and resists shock.

It is easy to cut, drill and erect.

It makes a good looking job.

The illustrations show a few mountings where Ebony Asbestos Wood was used to advantage. Let us send you a complete descriptive booklet.

JOHNS-MANVILLE Inc., 292 Madison Avenue at 41st Street, N.Y.C
Branches in 62 Large Cities
For Canada: CANADIAN JOHNS-MANVILLE CO., Ltd., Toronto

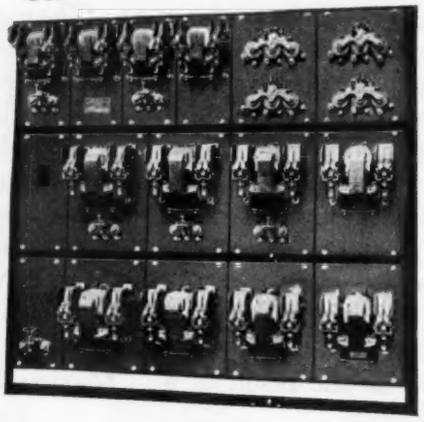


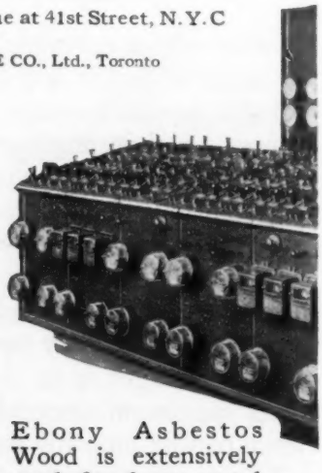
Note the drill holes in the Ebony Asbestos Wood strips. This drilling can be done without chipping and without seriously weakening the strips.

Installation at Philadelphia & West Chester Traction Company, 69th St. Terminal, Philadelphia, Pa., under the direction of A. E. Garwood, Supt.

This shows the use of Ebony Asbestos Wood for shovel hoist controller panels. Here its workability makes for easy drilling and machining.

This control board made by Cutler-Hammer Manufacturing Co.





Ebony Asbestos Wood is extensively used for large panel and bench board installations because it is so much easier to erect.

Above installation by the Dept. of Public Service, Bureau of Power & Light, Los Angeles, Calif.

JOHNS-MANVILLE SERVICE COVERS THIS CONTINENT

Through—

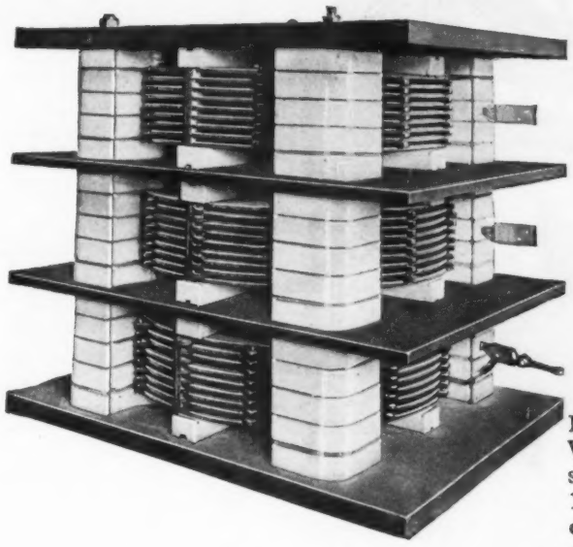
Electrical Materials

FOR

Utilities
Jobber
Contractor
AND
Dealer

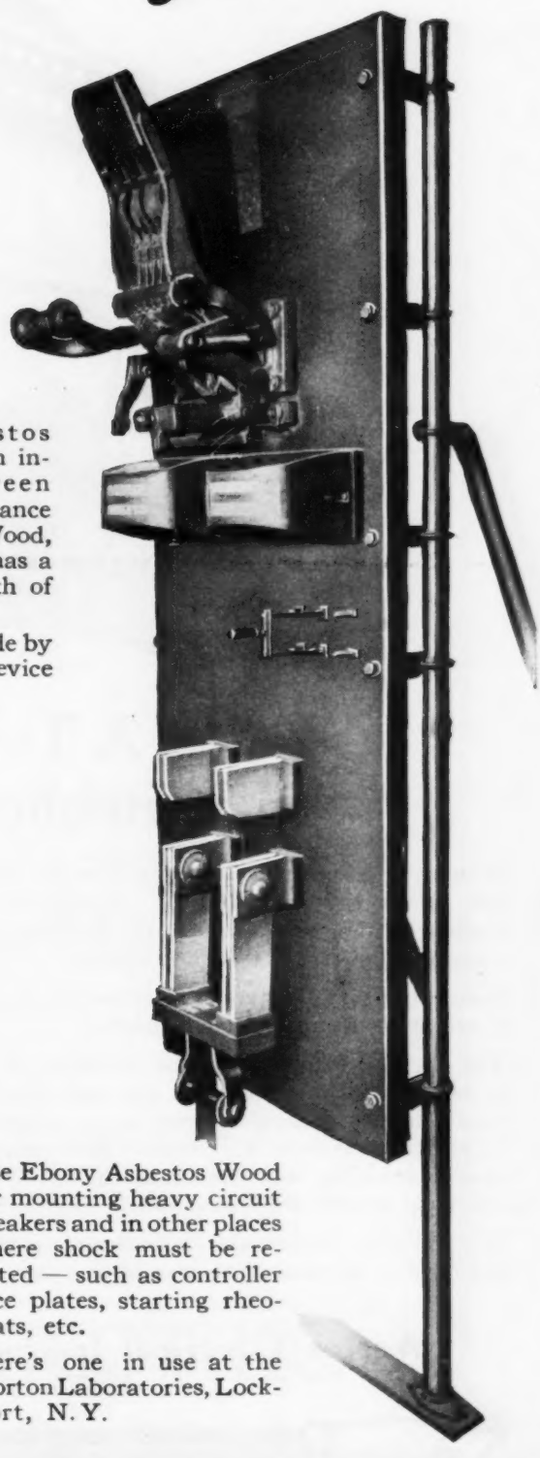
JOHNS-

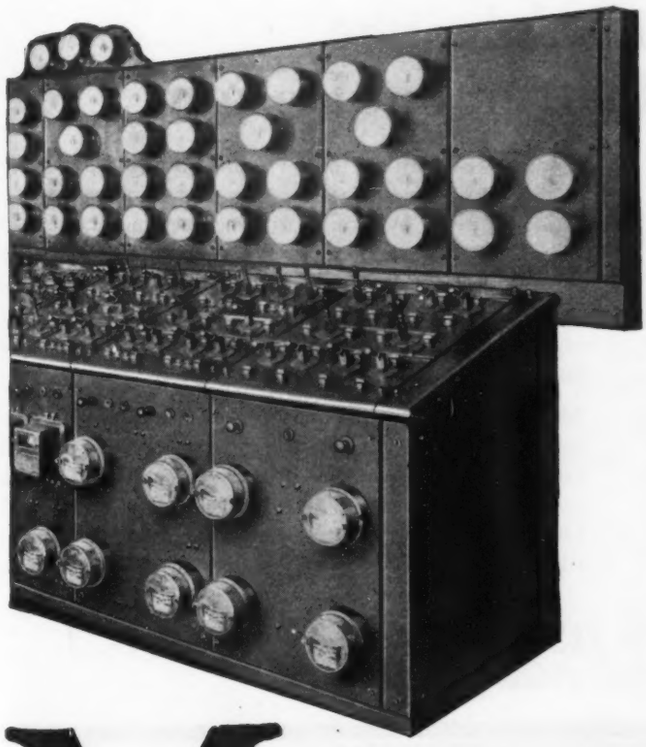
Wood work for you



Ebony Asbestos Wood used as an insulator between 11,000 v. reactance coils. Ebony Wood, one inch thick, has a dielectric strength of 76,000 V.

This reactor made by Metropolitan Device Corp.





Use Ebony Asbestos Wood for mounting heavy circuit breakers and in other places where shock must be resisted — such as controller face plates, starting rheostats, etc.

Here's one in use at the Norton Laboratories, Lockport, N. Y.

MANVILLE

A Towering Advance in Switchboard Instrument Design

Weston Rectangular Instruments have created a sensation in the electrical industry. Because of the space economy feature alone, switchboard designers have taken a profound interest in these instruments.

Standard Specifications are being revised in many instances to permit the use of these instruments.

The electrical industry is on the threshhold of a new era in switchboard design to meet new and exacting conditions. In fact, leading engineers have gratuitiously proclaimed that Weston Rectangular Instruments are the most noteworthy contribution to the art of electrical indicating switchboard instruments in fifteen years.

With Weston Rectangular Instruments, a four circuit panel can be accommodated on a 24 in. panel.

As compared with the former round pattern type, the space saving in square feet for a four circuit panel is in the ratio of 5 to 9. Weston quality has been maintained. But the size of each instrument has been reduced to 5¾ inches in width and 6 inches in height. Instruments project only 4¼ inches from the face of the board. And because of the wide scale openings and improved illumination, instant and certain readings are assured.

Many features, highly important to the designer who is planning for the future, are incorporated in these new instruments. These also include economy and standardization in rear of the switchboard as well as in front of it. Our new booklet 1504 especially prepared for you, gives all the details. A copy will be sent promptly on request.

Weston Electrical Instrument Co., 13 Weston Ave., Newark, N. J.

Branches in Principal Cities Throughout the World

Electrical Indicating Instrument Authorities Since 1888

WESTON

STANDARD - The World Over

Reactors—an exclusive feature of G-E Static Condensers

The question is sometimes asked: "Why does G-E furnish a reactor as part of static condenser equipment?"

A rather complicated engineering analysis might be given as the answer. In simple terms, the reason is: To make sure the condenser will work to its full capacity.

You install a static condenser to improve your power factor and thereby liberate wattless current to do useful work. The percentage of corrective effect desired determines the size of condenser to install. But whether it will work to full capacity depends on your line conditions. To do field engineering in connection with each static condenser installation is impracticable. The reactors furnished with G-E Static Condensers make it unnecessary.

That reactance is essential to the operation of static condensers has been shown by experience. For instance, some condensers installed on very short feeders were not effective; the same equipments moved to the ends of long feeders connected to the same bus gave excellent satisfaction. They were dependent on the reactance of the line.

G-E Static Condensers are effective to their full capacity, because sufficient reactance is furnished with each to insure correct operating conditions.

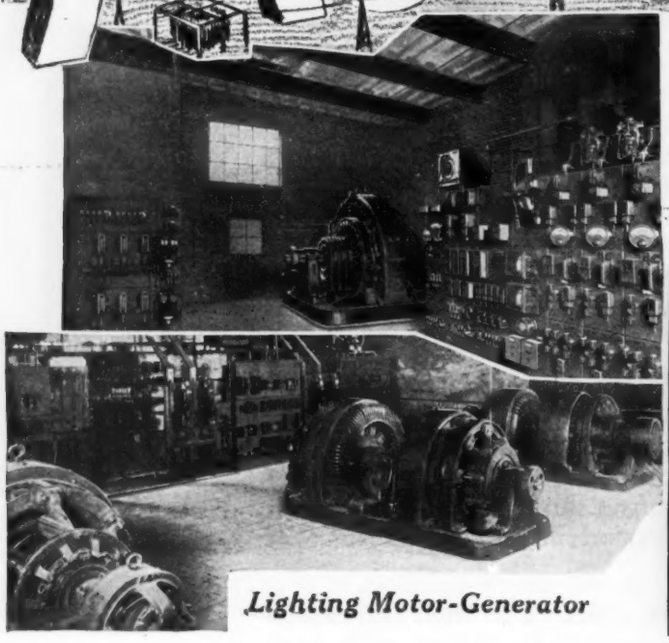
A big reason for investigating the other merits of G-E Static Condensers.

General Electric Co. Schenectady, N. Y.

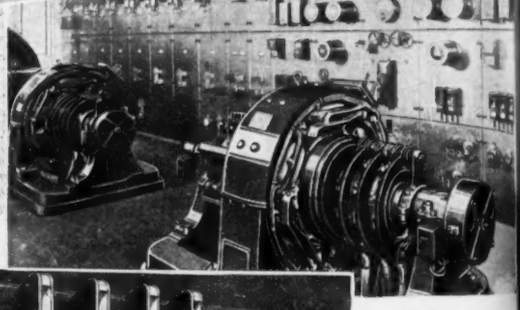
33A-205

GENERAL ELECTRIC

Automatic

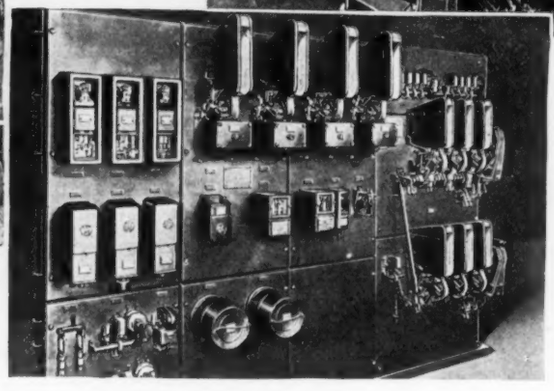


City Railway



Mining Converter

Lighting Motor-Generator



Industrial Converter

Make it an Automatic

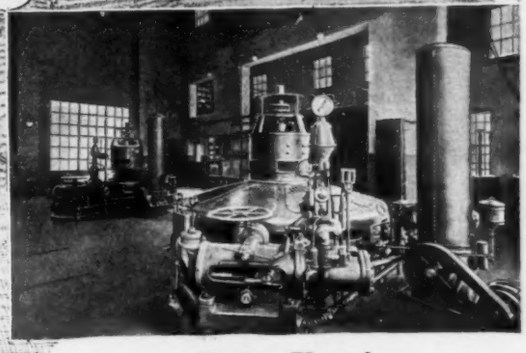
THESE installation pictures represent some of the services to which G-E Automatic Switching Equipment has been applied. In fact, the control of any element of electricity supply systems except a steam turbine can now be done by automatic means.

G-E Automatic Stations maintain electric service as required, clear circuits in case of trouble and protect equipment when starting, running and stopping. Every day they demonstrate their reliability and permit operating economy well worth your consideration.

G-E engineering specialists to advise you on this subject are everywhere. Perhaps there is one in your city. Call him.

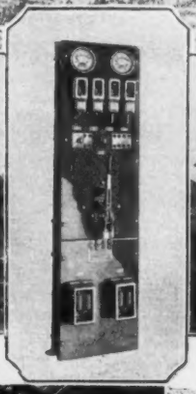
GENERAL

Stations



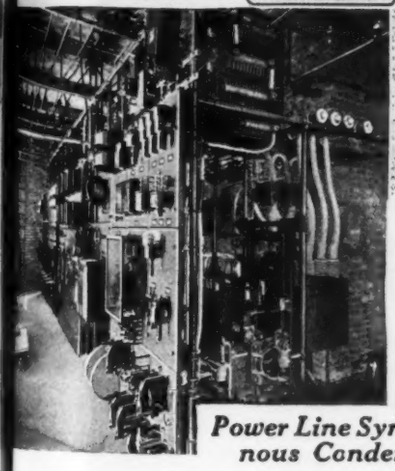
Hydro-Electric

Railway Signal

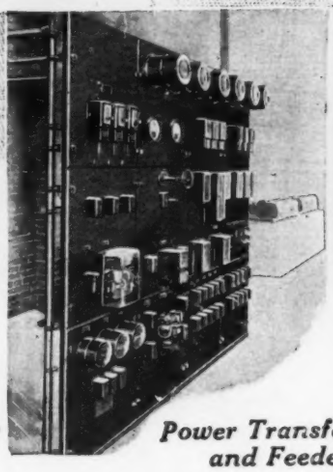


Equipment

Elevator 4-Unit Balancers



Power Line Synchronous Condenser



Power Transformer and Feeders

".....we had a very severe electrical storm at which time one of the equipments at.....operated 12 times. This happened early in the morning when there was no attendant at the station, so that none of our representatives had personal knowledge of the interruptions. The evidence appeared on the counters which we installed on these automatic equipments before putting them in service. When the operator visited the plant in the morning he discovered that 12 cases of trouble had been 'rung up' during the night.

"We are very much pleased with the equipment and wanted to submit above testimonial."

From Customer's report. Name will be furnished on request.

General Electric Company
Schenectady, N. Y.
Sales Offices in all Large Cities

ELECTRIC

548-87

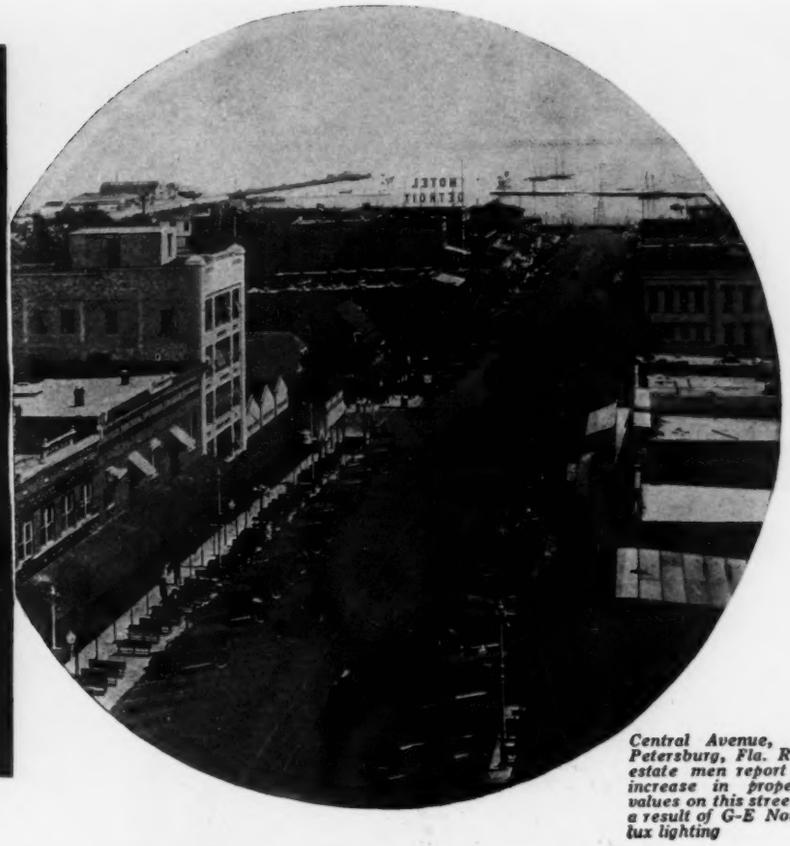
The cell of Oxide Film Arresters has the largest area of any modern valve-type arrester. It is this feature which enables the Oxide Film Arrester to discharge disturbances with appreciable time element so effectively.

General Electric Company
Schenectady, N. Y.
Sales Offices in all Large Cities

GENERAL ELECTRIC

33E-49

G-E Form 8 Novalux Fixture



Central Avenue, St. Petersburg, Fla. Real estate men report an increase in property values on this street is a result of G-E Novalux lighting

Florida's "Sunshine City" Is to Have a Novalux White Way

Nine miles of G-E Novalux units with rippled globes will adorn Central Avenue, St. Petersburg, Florida, making this thoroughfare the longest "White Way" in the world. This unit, giving a symmetrical distribution of sparkling light, won out over many different types of fixture.

A new addition of 740 Form 8 units mounted on "Elreco" brackets and poles with a G-E Type IL transformer at the top of each pole, will make a total of 850 Novalux fixtures on this street. The installation is of interest as an ideal example of the use of Mazda lamps for symmetrical "White Way" illumination.

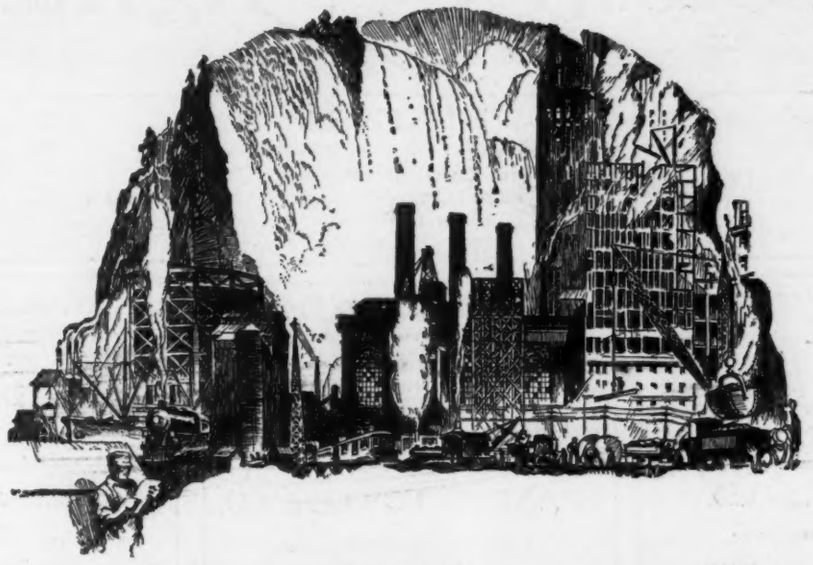
The General Electric Company maintains extensive laboratories devoted exclusively to the application of light. A pioneer in the development of all types of lighting unit, this company is prepared to serve and advise with impartial judgment.

General Electric Company
Schenectady, N. Y.
Sales Offices in all Large Cities

35C-151

GENERAL ELECTRIC

DAYS
KERITE
KERITE INSULATED WIRE & CABLE CO
KERITE
in a half-century
of continuous
production,
has spun out
a record
of performance
that is
unequalled
in the history
of
insulated wires
and cables.
KERITE INSULATED WIRE & CABLE COMPANY
NEW YORK CHICAGO
Lillibridge 60-592



Financing a Nation's Industries

The early history of banking makes it evident that little consideration was given to the important part which it was destined to play in the industrial development and progress of the world. Apparently the first recognition that was given to the true relation between conservative banking and industry was when the early money merchants of Venice, Barcelona and Genoa began to finance the producers and distributors of merchandise and others who were rendering a real economic service.

The growth of this financing was made possible by the increasing supply of funds which were left temporarily on deposit with the merchant bankers, thus making available for industry capital which would otherwise have remained idle and unproductive.

It was from these beginnings that the great banking and investment business of the world has developed. In gathering together and making available the surplus funds of the country for constructive use and worthy development, the investment banking houses are performing an important public service, besides aiding in the safeguarding of the funds of investors by creating and maintaining for them a constant supply of sound investments.

Without this necessary service there could never have occurred the wonderful development which has been witnessed within a lifetime, in the transportation, electric light, water power, telephone, manufacturing and other large industries of the country.

Capital available for investment is simply the accumulated savings of the people. Everyone is harmed when these savings are wasted and everyone shares in the benefits resulting from the wise utilization of this accumulated investment fund.

It is the high and useful calling of the investment banker to serve both the producer and the investor—to safeguard savings by directing their investment in enterprises which are sound, and to aid the corporation, the merchant and the manufacturer by furnishing them with capital to provide the service and the commodities that add to our comfort and prosperity and are necessary to our very existence.

Since 1882—for more than forty years—the investment banking house of Harris, Forbes & Company, through its purchase and distribution of Municipal, Railroad, Public Utility and Industrial Bonds, has actively aided in the development of nearly every section of the country while the service it has thereby rendered to investors has increased from year to year.

Upon request for Circular B-111 we shall be pleased to send a copy of our July Bond Offerings

Harris, Forbes & Company

Pine Street, Corner William, New York

Harris, Forbes & Company
Incorporated
Boston

Harris, Forbes & Company
Limited
Montreal

Harris Trust and Savings Bank
Bond Department
Chicago

Directory of Engineers

JAMES E. ALLISON & CO.
CONSULTING ENGINEERS
Specializing in Utility Rate Cases and Reports to Bankers and Investors
1017 Olive Street St. Louis, Mo.

Ambursen Construction Co.
Incorporated
AMBURSEN DAMS
Hydroelectric Developments
Water Supply and Irrigation Dams
DAMS ON DIFFICULT FOUNDATIONS
Grand Central Terminal, New York.
Kansas City, Mo. Atlanta, Ga.

THE ARNOLD CO.
Engineers, Constructors
Electrical—Civil—Mechanical
105 So. La Salle Street, Chicago

BYLLESBY
ENGINEERING AND MANAGEMENT CORPORATION
208 S. LaSalle Street Chicago
New York Tacoma

EDWARD J. CHENEY
ENGINEER
Public Utility Problems
For several years Division Chief with up-state New York Public Service Commission
61 BROADWAY NEW YORK

HUGH L. COOPER & CO.
General Hydraulic Engineering, including the design, financing, construction and management of hydro-electric power plants.
101 Park Ave. New York

DAY & ZIMMERMANN, Inc.
ENGINEERS
Power Plants, Sub-Stations, Transmission Lines, Industrial Plants, Examinations and Reports, Valuations, Management of Public Utilities.
1600 Walnut St., Philadelphia
New York City Chicago

ELECTRICAL TESTING LABORATORIES
Electrical and Mechanical Laboratories
Tests of Electrical Machinery, Apparatus and Supplies, Materials of Construction, Coal, Paper, etc. Inspection of Material and Apparatus at Manufactories.
80th St. and East End Ave., New York

FARGO ENGINEERING CO.
CONSULTING ENGINEERS
Jackson, Michigan
Hydro-Electric and Steam Power Plants
Difficult Dam Foundations

ROGER M. FREEMAN
CONSTRUCTION ENGINEER
Hydro-Electric Developments
Design and Construction of Industrial Buildings
8 West 40th St., New York City

FORD, BACON & DAVIS
Incorporated
ENGINEERS
115 Broadway
NEW YORK
Philadelphia Chicago San Francisco

FRANK F. FOWLE & CO.
Electrical and Mechanical ENGINEERS
Monadnock Building Chicago, Ill.

GANNETT, SEELYE & FLEMING, ENGINEERS, INC.
Engineering, Appraisals, Construction, Management
Harrisburg, Pa. Memphis, Tenn.

HARPER & TAYLOR
Incorporated
ENGINEERS
Bankers Trust Bldg., Philadelphia
Niagara Falls, N. Y.

L. F. HARZA
HYDRO-ELECTRIC ENGINEER
Monadnock Bldg. Chicago

HOOSIER ENGINEERING COMPANY
Erecting Engineers
Transmission Lines
Substations
325 So. New Jersey St., Indianapolis, Ind.

IVES & DAVIDSON
ENGINEERS
Construction—Management—Valuation
PUBLIC UTILITY PROPERTIES
Design—TRANSMISSION LINES—Build
15 Park Row, New York

KREHBIEL COMPANY
Specializing in Power Plants, Transmission Lines, Distribution Systems.
730 W. Monroe St., Chicago

WILLIAM S. LEE
Mem. Am. Soc. C. E.
Mem. Am. Soc. M. E.
Mem. Eng. Inst. Can.
Fellow Am. Inst. E. E.
Chief Engineer Southern Power Company
CONSULTING ENGINEER
511 Fifth Avenue, New York City
Charlotte, North Carolina

E. S. LINCOLN
Consulting Electrical Engineers
Designs Investigations Reports
Electrical Research Laboratory
534 Congress St., Portland, Maine

McClellan & Junkersfeld
Incorporated
ENGINEERING AND CONSTRUCTION
Power Developments, Industrial Plants, Examinations, Reports, Management.
New York: 68 Trinity Place
Chicago Philadelphia St. Louis

DANIEL W. MEAD
F. W. SCHEIDENHELM
Consulting Engineers
Hydro-electric Developments, Water Supply, Irrigation, Drainage, Flood Control.
New York City, 30 Church St.

MINCHO & PHILLIPS
Electrical and Mechanical ENGINEERS
30 Church Street New York

ARTHUR L. MULLERGREN
CONSULTING ENGINEER
Specialist in
Electric Light, Power and Water Pumping.
555 Gates Building, Kansas City, Mo.

N. J. NEALL
Consulting Engineer
Electrical and Industrial Properties
12 PEARL STREET, BOSTON, MASS.

OKLAHOMA HIGH LINE CONSTRUCTION COMPANY
ENGINEERS
Transmission Lines, Sub-Stations, Power Plants, Industrial Plants, Railroad Electrification.
Designs, Reports and Appraisals.
805 Mayo Building, Tulsa, Okla.
P. J. Mineck C. Blue

OPHULS & HILL, Inc.
formerly
OPHULS, HILL & McCREERY, INC.
Consulting Engineers
Ice Making and Refrigeration Investigations and Reports.
112-114 West 42nd St., New York City

Directory of Engineers

PARSONS, KLAPP, BRINCKERHOFF & DOUGLAS
Engineers Constructors Managers
Hydroelectric, Steam & Industrial Plants and Structures designed, built and operated
84 Pine Street, New York
Hanna Bldg., Cleveland, O.

E. Y. SAYER ENGINEERING CORPORATION
Specialize in
The Design and Construction of Steam Power Plants and Water Power Developments for Public Utility and Industrial Companies.
Knickerbocker Bldg., Broadway and 42nd St. New York, N. Y.
202 North Calvert St., Baltimore, Md.

STEVENS & WOOD, Inc.
Design and Construction of Power Stations
Railroad Electrification, Industrial Plants
Reports and Appraisals
Management and Financing of Utilities and Industrials
Youngstown New York

PUBLIC SERVICE PRODUCTION COMPANY
Engineers and Constructors
Design and Construction of Power Plants, Substation and Industrial Plants, Examination and Reports, Valuation and Management of Public Utilities.
80 Park Place, Newark, N. J.

SCOFIELD ENGINEERING CO.
Consulting Engineers
Power Stations Gas Works
Hydraulic Developments Electric Railway
Philadelphia

Thebo, Starr & Anderton, Inc.
ENGINEERS AND CONSTRUCTORS
Specializing in Design and Construction of Power Plants, Hydro-Electric, Irrigation and Industrial Projects. Appraisals, Investigations, Reports, Plans and Specifications.
Sharon Bldg., San Francisco. Fresno, Cal.

W. EDGAR REED
Consulting Engineer
Designer of Electrical Machinery
Estimates, Reports, Plans, Specifications and Supervision of Lighting, Railway, Industrial and power Installations.
585 Union Arcade Bldg., Pittsburgh, Pa.

SESSIONS ENGINEERING CO., INC.
ENGINEERS AND CONSTRUCTORS
Steam Appraisals
Electric — Plants — Surveys
Hydro Reports
Lumber Mill Layouts
208 S. La Salle St. Chicago

PERCY H. THOMAS
CONSULTING ENGINEER
POWER
DESIGN, SUPERVISION, ADVICE
120 Broadway, New York City

DWIGHT P. ROBINSON & CO.
INCORPORATED
Design and Construction of Power Developments, Electric Railway Work Industrial Plants
125 East 46th Street, New York
Chicago Atlanta Philadelphia Youngstown
Los Angeles Montreal Rio de Janeiro

EDWARD P. SMITH
Valuator of Public Utilities
Specializing in Public Utility Investigations, Valuations and Reports; also in Public Utility and Industrial Financing.
Harris Trust Building, Chicago

The J. G. White Engineering Corporation
Engineers — Constructors
Oil Refineries and Pipe Lines, Steam and Water Power Plants, Transmission Systems, Hotels, Apartments, Office and Industrial Buildings, Railroads.
43 Exchange Place New York

SANDERSON & PORTER
Engineers
Reports, Designs, Construction, Management
Hydro-Electric Developments.
Railway, Light and Power Properties.
Chicago New York San Francisco

SNOOK-HILLHOUSE CO.
CONSULTING ENGINEERS
Utility and Industrial Appraisals
Construction Supervision
Estimates Designs—Patents
Plans Financing
Columbus, Ohio

GARDNER S. WILLIAMS
Consulting Engineer
Water Power and Electrical Developments, Reports Designs, Specifications, Surveys, Superintendence, Estimates, Appraisals.
Cornwell Building. Ann Arbor, Mich.

SARGENT & LUNDY
Incorporated
Mechanical and Electrical Engineers
1412 Edison Bldg.
72 West Adams St.
Chicago, Ill.

SPOONER & MERRILL
Consulting Engineers
Utility and Industrial Reports, Design, Supervision, Appraisals
Powers B'dg., Grand Rapids, Mich.
with G. H. KNUTSON, Financial Engr.
Harris Trust Bldg., Chicago, Ill.

WOOD & WEBER
Mechanical and Electrical Engineers,
Designs—Reports—Appraisals.
General Engineering.
507 Tramway Building Denver, Col

Advertising —

as a builder of prestige and business standing is unquestioned. It is an immeasurable power in influencing new business and retaining good-will.

Professional Cards —

in this paper offer a highly appropriate type of publicity for the services of professional men in the Electrical field.

Your Card —

should appear in this directory regularly. If it is not there now—

CLIP AND MAIL THIS COUPON →

Professional Directory Department
ELECTRICAL WORLD
10th Ave., at 36th St., N. Y.

Gentlemen:

Please send us rates and other data for advertising in your PROFESSIONAL DIRECTORY.

SEARCHLIGHT SECTION

USED EQUIPMENT & NEW—BUSINESS OPPORTUNITIES

UNDISPLAYED—RATE PER WORD:
Positions Wanted, 4 cents a word, minimum 75 cents an insertion, payable in advance.
Positions Vacant and all other classifications, 8 cents a word, minimum charge $2.00.
Proposals, 40 cents a line an insertion.

INFORMATION:
Box Numbers in care of any of our offices count 10 words additional in undisplayed ads.
Discount of 10% if one payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals).

DISPLAYED—RATE PER INCH:
1 to 3 inches.....$5.00 an inch
4 to 7 inches.....4.80 an inch
8 to 14 inches.....4.60 an inch
Rates for larger spaces, or yearly rates, on request.
An advertising inch is measured vertically on one column, 3 columns—30 inches—to a page.

E.W.

POSITIONS VACANT

EXPERIENCED electrician for position in service department of growing utility in Southeast wanted. Must be experienced in all electrical work encountered in large generating and sub-stations as well as in transformer and motor operation and repairs. State age, education, nationality, whether married or single and salary expected. Give reference and send photograph in first letter. P-830, Electrical World, Real Estate Trust Bldg., Phila., Pa.

GRADUATE electrical engineer, well grounded in mathematics, to assist in theoretical investigations of large central station power system operating problems. Desirable that applicant have familiarity with characteristics of power plant machinery, transmission lines, switchgear, relays, etc. State age, experience and salary expected. P-841, Elec. World, 10th Ave. at 36th St., New York.

MAN wanted to take charge of manufacturing department of electric motors and generators; must be familiar with all phases of manufacturing of electrical machinery must know how to reduce cost and to handle men technical electrical graduate preferred but not a requirement; state salary wanted and age in application. P-832, Electrical World, 10th Ave. at 36th St., New York.

METER engineer, college graduate preferred with at least four years' experience in connection with meter department routine. Must be qualified to supervise tests, inspections and wiring checks of watthour meters and maximum demand equipment on high tension installations. Alternating current theory essential. State salary desired and when available. Send photograph and copy of references. Location, New York City. P-840, Electrical World, 10th Ave. at 36th St., New York.

EMPLOYMENT SERVICE

OVERTURES negotiated through the confidential correspondence service of the undersigned, for salaried positions $2,500 to $25,000—executive, mechanical, administrative, engineering, technical financial, manufacturing, sales, advertising, professional, etc., etc.; all lines. Established fourteen years; not an employment agency. Retaining fee refunded as provided in our "Refund Contract" if service is not satisfactorily rendered as per contract, and such refund be requested within three months from date remitted. Send name and address only for particulars. R. W. Bixby, Inc., 705 Lockwood Building, Buffalo, New York.

EXECUTIVES, engineers, $3,000-$25,000, will find our individual, confidential service an effective medium in making new connections. Personally conducted by Mr. Jacob Penn, the eminent employment authority, known to leading business men throughout America. Our refund agreement protects you. Not employment agency. Jacob Penn, Inc., 305 Broadway, New York.

BE A METER ENGINEER

Get in the new profession. We can teach you meter engineering *by mail* at your own home during spare time. Successful graduates everywhere.

Earn $3,600.00 a Year.

Central stations *must have Electrical Meter Engineers.* They pay high salaries. *Write today.* Just your name and address on a postal and we will send you full particulars free. Ft. Wayne Correspondence School, Dept. 46, Ft. Wayne, Ind.

EMPLOYMENT SERVICE

EXECUTIVES, engineers and other qualified men whose salary requirements are over $2,500 per year, find out confidential direct service to specific employers extremely satisfactory. An inquiry entails no obligation. The National Business Bourse, Inc., H. H. Harrison, President, Association Bldg., Chicago.

POSITIONS WANTED

CHARTERED electrical engineer, Associate Member Institution Electrical Engineers, England, desires position United Kingdom or India; American merchant house, influential connection. PW-831, Electrical World, Real Estate Trust Bldg., Phila., Pa.

COMPETENT electrician wishes change; seven years' experience, power plant operator and maintenance; good education. PW-797, Electrical World, Old Colony Bldg., Chicago, Ill.

DESIGNER of steam turbines and turbo blowers desires position; 5 years' exclusive experience in this line; familiar with thermodynamical and strength calculations, speed regulation, and efficiency test. At present in responsible position. PW-839, Electrical World, Real Estate Trust Bldg., Phila, Pa.

ELECTRICAL engineer with executive construction and operating experience capable of readjusting distribution systems for power factor correction, desires new connection. Available immediately. PW-812, Electrical World, 10th Ave. at 36th St., New York.

ELECTRICAL and mechanical engineer, expert mechanical designer of electrical machinery, with particular reference to critical speeds, dynamic balance, and elimination of vibrations, desires permanent position with electrical manufacturer; 15 years' experience; change desired on account of climatic conditions. PW-838, Electrical World, Real Estate Trust Bldg., Phila., Pa.

ELECTRICAL engineering graduate 1919, desires position in Kansas with privately or municipally owned public utility. Experience includes three years' management small public utilities, one year design large power station. Age 27; married; available reasonable notice; salary $200 month. PW-834, Electrical World, Old Colony Bldg., Chicago, Ill.

ELECTRICIAN—Semi-technical, 13 years' experience power and light constructions and AC and DC maintenance, age 30, single; will go anywhere; good reference from present and former employers; available at once. PW-828, Elec. World, Leader-News Bldg., Cleveland, Ohio.

ELECTRICIAN, 12 years' experience, technical, I. C. S. practical, maintenance, inspection, testing and operating; now employed; desire steady responsible position with manufacturing or public utility concern, anywhere, 33, married, loyal hard worker, reference, moderate salary; 15 days notice. PW-836, Electrical World. 10th Ave. at 36th St., New York.

ERECTION superintendent, electrical-mechanical, exceptional experience power house, substation and industrial construction; technically educated; member several national engineering societies; former army officer; single, age 40; state class of work, location and salary. PW-792, Electrical World, Old Colony Bldg., Chicago, Ill.

POSITIONS WANTED

EXECUTIVE: Four years' experience in the development, financing and operation of light and power lines to rural communities and small towns, under plan by which consumer bears line and transformer investment. Desire connection with power company contemplating such developments. PW-826, Electrical World, Leader-News Bldg., Cleveland, Ohio.

FOREMAN of overhead construction and distribution desires location in Southeastern Pennsylvania, Maryland or Virginia; at present employed. PW-802, Electrical World, 10th Ave. at 36th St., New York.

GRADUATE electrical engineer, age 34, single, available for responsible position with public utility, preferably affording business connection; thirteen years' varied technical and commercial experience with large electric companies covering operation, power sales, rates, engineering and construction lines and stations. PW-803, Electrical World, Old Colony Bldg., Chicago, Ill.

MANAGER or superintendent, public utility, open for engagement with progressive company, 12 years' experience, gas, electric, and street railway properties; technical training; excellent reference. PW-771, Electrical World, Old Colony Bldg., Chicago, Ill.

METER tester; four years' experience in calibration and maintenance of single-phase, polyphase and primary meters; at present employed in testing and maintaining meters for large manufacturing company; married, age twenty-four; capable of taking charge of meter department. PW-807, Electrical World, Real Estate Trust Bldg., Phila., Pa.

POSITION with progressive electric public utility in East by college graduate engineer, married, age 42; fourteen years' experience in public utility work covering engineering, construction, operation, power application, negotiation contracts with large consumers, rate making, estimates and commercial management. To demonstrate ability will consider most anything promising advancement with right company; highest references. PW-835, Electrical World, Leader-News Bldg., Cleveland, Ohio.

PROFESSIONAL qualified construction engineer with twelve years' experience as field engineer and general manager of construction of one thousand miles of steel tower transmission and three hundred miles of modern electric railway overhead, open for position. PW-833, Electrical World, 10th Ave. at 36th St., New York.

WANTED, position by a married man capable of doing switchboard wiring, construction, maintenance and operating; six years' experience in hydro, steam and substation, also I. C. S. electrical engineer graduate. PW-808, Electrical World, 10th Ave. at 36th St., New York.

SALESMEN WANTED

Commercial Manager

Man qualified by experience in power sales and merchandising to take charge of new business and appliance sales department of electric utility. Location New Jersey. State experience, personal characteristics, and salary expected in first letter. SW-827, Elec. World, 10th Ave. at 36th St., New York.

SALESMEN WANTED

Experienced A. C. Motor Salesman

Electrical engineering graduate, for Chicago district. The Electric Controller & Mfg. Co., 2700 E. 79th St., Cleveland, O.

Salesmen

A company operating several gas and electric plants desires to secure the services of salesmen who have had experience in selling gas or electric appliances as well as house-wiring contracts. Steady, all-year positions at profitable compensation. SW-825, Electrical Work, 10th Ave. at 36th St., New York.

Technical Graduate Wanted

for power sales and special distribution work. Give references, experience and salary expected. SW-823, Electrical World, Leader-News Bldg., Cleveland, Ohio.

AGENCY WANTED

Manufacturers Agent

Gentleman knowing all British Isles would consider taking back agency; ground covered over 10 years; write immediately Frank Rawcliffe, Cassidy Hotefi, Wilmington, Del.

REPRESENTATIVES WANTED

Manufacturers' Agents Wanted

to represent manufacturer in the Middle West manufacturing complete line of residence entrance switches, also special switches and switchboards. Representatives wanted in all large cities throughout the United States. RW-829, Elec. World, Leader-News Bldg., Cleveland, Ohio.

High-Class Electrical Sales Representatives

wanted by the undersigned who are manufacturers of carbon, graphite, electrographitic and metallic brushes for motors and generators, also general line of carbon specialties. Exclusive rights given to each of territories on liberal straight commission sales proposition. Specify in detail past engineering and sales experience. Application by letter. Pure Carbon Company, Wellsville, N. Y.

REPRESENTATION AVAILABLE

UNIVERSITY graduate in mechanical engineering, with 15 years' shop and sales experience, establishing own business, desires two power plant apparatus accounts for representation in New York or New England. RA-790, Electrical World, 10th Ave. at 36th St., New York.

ENGINEER with sales experience desires to make contact with eastern manufacturers of electrical or mechanical apparatus for California territory sales representation. Now in New York. Returning to coast about July seventh. RA-842, Elec. World, 10th Ave. at 36th St., New York.

BUSINESS OPPORTUNITIES

Wanted to Buy

electric light plant in town of 800 or more that will insure good living. BO-837, Electrical World, 10th Ave. at 36th St., New York.

EDUCATIONAL

BLISS Electrical School. Condensed courses in electrical engineering with diploma, complete in one year. For men of character, ambition and limited time. Theoretical principles and practical applications of electricity, mathematics, mechanical drawing. Extensive shop work. Students construct motors, install wiring and test electrical machinery. Fireproof dormitories, dining hall, laboratories, shops. Established 1893. Over 4,000 men trained. Write for free catalog. 128 Takoma Ave., Washington, D. C.

SEARCHLIGHT SERVICE SECURES SATISFACTORY SITUATIONS

2003

OFFICIAL PROPOSALS

Bids: August 4.

Morwell Power Scheme

SPECIFICATION NO. 24/25
STATE ELECTRICITY COMMISSION OF VICTORIA

Melbourne, Victoria, Australia.

Tenders are hereby invited for the supply, delivery, etc., of the following for the Morwell Power Scheme.

Copies of Tender Form and Specification will be available upon application to:

Office of the Bureau of Foreign & Domestic Commerce, United States Department of Commerce, Room 830, 76 West Monroe St., Chicago, and Office of the Bureau of Foreign & Domestic Commerce, United States Department of Commerce, 734 Customs House, New York City.

SPECIFICATION NO. 24/25—66,000-VOLT INSULATORS

Charge: £2 2s. 0d. for the first three copies of Tender Form, Conditions of Contract and Specification complete. This charge will be returned on receipt of a bona fide tender. A fourth copy and any further copies will be supplied for the sum of 10s. 6d. each. This charge is not returnable.

Preliminary Deposit: A Preliminary Deposit of £50 0s. 0d. is to be lodged with Tender.

The Specification may be inspected at the abovementioned offices.

The Commission does not bind itself to accept the lowest or any tender.

Tenders on prescribed form, properly endorsed and addressed, must be delivered to the undersigned in Melbourne not later than 5 p.m. on August 4, 1924.

R. LIDDELOW,
Secretary.

U. S. GOVERNMENT

PROPOSAL FOR Diesel Engine Driven Generator Equipment for Stand-by Generator Stations.—Sealed proposals will be received at the office of the General Purchasing Officer, The Panama Canal, Washington, D. C., until 10.30 o'clock a.m., July 21, 1924, at which time they will be opened in public, for furnishing the above-mentioned equipment. Blanks and information relative to this Circular (1617) may be obtained from this office or the offices of the Assistant Purchasing Agents, 24 State Street, New York City; 611 Gravier Street, New Orleans, La.; and Fort Mason, San Francisco, Calif.; also from the United States Engineer Offices in the principal cities throughout the United States.—A. L. Flint, General Purchasing Officer.

In the SEARCHLIGHT SECTION there is something of interest for Every Reader

Different Each Week

The business wants of concerns and individuals are varied and always changing. Each day brings new wants; each day finds others filled.

The SEARCHLIGHT SECTION

of this paper advertises the business wants of the organizations and men in this field. As their wants change, so do the "Searchlight" ads.

For Every Business Want
Think "SEARCHLIGHT" First

G-20

WANTED

WANTED

MOTOR

1—150-hp., 3-ph., 60-cy., 440-v.

READING ENGINEERING WORKS
116-20 Washington St., Reading, Pa.

WANTED

STEEL PILING

any part or all of
300 wall feet 25 to 30 ft. lengths
180 wall feet 35 to 45 ft. lengths

W-330, Electrical World
1570 Old Colony Bldg., Chicago, Ill.

WANTED

STEEL PILING

For Hydro Electric Project 13 to 19 ft. lengths. Also longer piles suitable cutting these lengths.

W-806, Electrical World
1570 Old Colony Bldg., Chicago, Ill.

GREGORY REBUILT

Motors, Generators, Meters, Transformers reconditioned *like new* — guaranteed — sold at prices far below the original cost.

GREGORY ELECTRIC CO.
1612 AND LINCOLN STS. CHICAGO, ILL.

USED ELECTRICAL MACHINERY.

***Every Month* we get out a new *Bargain Sheet*, showing complete stock with prices. Look it over, when received. Prices are continually being revised.**

Also many BARGAINS IN NEW 3 phase, 60 cycle Motors—220 volts—440 volts in original cases—all in stock—all *below regular prices.* Pick them out!!

3-Phase, 60-Cycle, A. C. Generators

Kw.			Speed
1	20	Roth revolving armature, 220 volts, single phase	1800
1	50	Westinghouse, type G, rev. field, 2300 v.	1200
2	60	G. E., type ATB, form B, rev. field, 220 or 440 v.	1200
1	60	Triumph, type A15, rev. field, 2400 v.	720
1	62½	Westghse., type G, rev. field, 2300 v.	1200
1	70	Westinghouse, rev. field, 2400 v. to 13x11 in. Harrisburg-Fleming steam engine	300
1	75	G. E., type ATB, form PB rev. field, 220 or 440 v.	1200
2	75	G. E., type ATB, form PB, rev. field, 2300 v.	1200
1	75	Western Elec., 2300 v. with sole plate, for direct-connection to engine	277
1	75	Crocker-Wheeler, rev. field 2300 v. to 12x12 in. McEwen horizontal steam engine	275
1	80	Allis-Chalmers, rev. field, 2300 v.	900
1	90	Electric Machinery, rev. field, 2300 v.	900
1	100	Westinghouse, type G, rev. field, 220 or 440 v.	1200
1	100	Westinghouse, type G, rev. field, 2300 v.	1200
2	100	G. E., type ATB, form P, rev. field, 2300 v.	900
3	112½	G. E., type ATB, rev. field, 220 or 440 v.	1200
2	112½	G. E., type ATB, form PB, 2300 v.	1200
1	112½	G. E., type ATB, form PB, rev. field, 2300 v.	900
1	120	G. E., type ATB, form PB, rev. field, 220 or 440 v.	900
1	125	Westghse., type G, rev. field, 2300 v.	900
1	150	G. E., type ATB, rev. field, 2300 v., 3-phase, with direct-connected exciter	600
1	150	Crocker-Wheeler, revolving field, 2300 v. to 15x15-in. Harrisburg-Fleming 4-valve side crank, steam engine	257
1	150	Crocker-Wheeler, revolving field, 440 v. to 15x15-in. Harrisburg - Fleming 4-valve side crank steam engine	257
1	187	G. E., type TRB, form A, rev. field, 2300 v.	600
1	200	Westinghouse, type G, rev. field, 22 or 440 v. 2300 volts	600
1	200	G. E., type ATB, form P, rev. field, 2300 v.	600
1	225	G. E., type ATB, form PB rev. field, 220 or 440 v.	720
1	312	G. E., type TRB, rev. field 2300 v. (3-bearing)	450
1	312	G. E., type TRB, rev. field 440 v. (3 bearing)	450

Three-Phase, 60-Cycle, A. C. Motors

Qu.	Hp.		Speed
1	5	G. E., type MT-181, 440-v. new, slip-ring, variable speed, with drum controller and resistance	1200
1	5	Westinghouse, type CCL, 220-v.	1150
1	5	Westinghouse, type CS, 440-v. for elevator, or similar service	720
1	7½	G. E., type KT, 220 v.	1800
2	7½	G. E., type KT, 440-v.	1800
3	7½	G. E., type KT, 440-v., new	1800
1	7½	Wagner, type BP, 220-v.	1720
1	7½	Mutual, type MC, 220-v., slip-ring, variable speed	1200
1	7½	Westinghouse, type CS, 220 or 440-v. for elevator or similar service	720
1	10	Lincoln, type HFX, 220 or 440-v., slip-ring, variable speed	1800
1	10	G. E., type MT, 220-v., new, slip-ring, variable speed	1800
12	10	Wagner, type BP, 220 or 440-v., new	1750
1	10	Westinghouse, type CW, 220-v., slip-ring, variable speed	1700
6	10	Westinghouse, type CS, 220-v.	1130
10	10	Westinghouse, type CS, 440-v.	1130
1	10	Allis-Chal., type AN, 440-v.	1130
1	15	Lincoln, 220 or 440-v., slip ring, variable speed	1800
15	15	Wagner, type BP, 220 or 440-v., new	1750
6	15	G. E., type KT, 220-v. new	1200

A. C. Motors Continued

1	15	G. E., form M, 220-v., slip ring, with drum starter and resistance	1200
1	15	G. E., type I, form M, 220 or 440-v. (40 deg.), new, slip-ring	1200
1	15	Westinghouse, type CI, 220-v., slip-ring, variable speed	1160
1	15	Allis-Chalmers, type AN 440-v	1150
1	15	Westinghouse, type CS, 440-v	1150
1	15	G. E., type KT, 440-v.	900
1	15	G. E., type KT., 220-v., new	900
4	20	G. E., type KT., 440-v., new	1800
12	20	Wagner, type BP, 220 or 440-v., new	1750
6	20	G. E., type KT., 220-v., new	1200
1	20	Wagner, type BP, 220-v.	900
5	20	G. E., type KT., 220-v., new	900
6	25	G. E., type KT., 220-v., new	1200
1	25	Wagner, type BP, 220-v	900
8	25	G. E., type KT., 220-v.	900
1	25	Lincoln, 440-v.	600
1	30	Westinghouse, type CCL, 440-v.	1150
1	30	Allis-Chalmers, type AN, 440-v., to Allis-Chalmers single stage centrifugal pump	1150
8	30	G. E., form K, 220-v.	900
1	30	G. E., type KT., 440-v.	900
3	30	Allis-Chalmers, type AN 440-v	850
4	30	Allis-Chalmers, type AN, 220 or 440 volts	575
2	35	G. E., form K, 440-v., American, single stage centrifugal pump	870
8	40	G. E., type KT, 220-v.	900
1	40	Westinghouse, type CS, 440-v	695
1	45	G. E., 440-v. (box frame), with short shaft for direct-connection	1750
1	50	Allis-Chalmers, type AN, 440-v	1800
1	50	Allis-Chalmers, type AN, 440-v. to Allis-Chalmers single-stage cent. pump	1750
1	50	Westinghouse, type CCL, 220-v.	850
1	60	Westinghouse, type MW, 220 or 440-v., slip-ring, variable speed	680
1	60	G. E., form —, 220 v.	570
1	60	G. E., form K, 220 v. (3 bearing)	570
1	75	G. E., form K, 2300-v.	1800
1	75	G. E., Type I, (box frame), 220-v	900
1	75	Allis-Chalmers, type AN, 440-v	865
6	75	Allis-Chalmers, type AN, vertical, 220-v.	514
1	100	G. E., form K, 220 or 440-v	800
2	100	Westinghouse, type CS, 440-v.	580
1	100	G. E., type I, form M, 2200-v., slip ring, with drum starter and resistance	514
3	120	G. E., type TRC, rev. field, synchronous motor, with belted exciter and starting equipmt., 220 v	1200
1	120	G. E., type ATB, form PB, rev. field, 2300-v., synchronous motor, with belted exciter and starting equipment	900
1	150	Westinghouse, type G, revolving field, 2300-v., synchronous motor with belted exciter	900
1	200	G. E., type I, form M, 220-v., slip-ring, with drum starter and resistance	600
1	200	Westinghouse, type CW, 220 or 440-v., slip-ring, with drum starter and resistance	580
1	250	G. E., type ATB, form PB, rev. field, synchronous motor with belted exciter and starting equipment, 220 or 440-v.	720
1	250	G. E., type ATB, form PB., rev. field, 2300-v., synchronous motor with belted exciter and starting equipment	720
1	250	Fairbanks-Morse, type HV ball bearing, slip-ring, constant speed, 220 or 440-v	600

A. C. Motors Continued

1	250	Westinghouse, type G, rev. field, synchronous motor with belted exciter and starting equipment: 220 or 440 volts	600
		2300 volts	600
3	250	G. E., type I, form M, 220 or 440 v., slip-ring, with T-29-A reversible drum starter and resistance	385

3-PHASE, 25-CYCLE MOTORS

Qu.	Hp.	Make	Speed
7	½	Wagner, type BP, 220-v.	1440
1	1	G. E., type KT, 220-v.	1500
1	1	Wagner, type BP 220 or 440-v.	1440
1	1	Northwestern, 220-v.	1420
3	1	Northwestern, 440-v.	1420
1	1	Wagner, type BP, 220 or 440-v.	1410
1	1	Robbins & Myers, type K, 220-v.	720
1	1	Westinghouse, type CCL, 220-v.	690
1	2	G. E., type KT, 220-v.	1500
1	2	Wagner, type BP, 220 or 440-v.	1420
1	2	Northwestern, 220-v.	1420
2	2	Robbins & Myers, type K, 220-v.	720
3	3	G. E., type KT, 440-v.	1500
1	3	Wagner, type BP, 220 or 440-v.	1440
3	5	G. E., type KT, 220-v.	1500
1	7½	Cleveland, type M, 220-v	1500
1	7½	St. Louis, 440-v.	1450
1	7½	Watson, type KH, 220-v	720
1	15	St. Louis, 220-v. (40 deg.)	1500
1	20	Fairbanks-Morse, type B, 220-v.	750
1	30	Fairbanks-Morse, 220-v. (40 deg.)	750
2	50	Allis-Chalmers, type AN, 220 or 440-v.	750
1	50	Fairbanks-Morse, type B, 220-v.	750
1	50	G. E., form K, 440-v.	750
1	60	Allis-Chalmers, type AN, 220 or 440-v.	720
1	100	G. E., type I, form M, 220 or 440-v., slip-ring, with drum starter and resist.	750
1	100	Wagner, type BR, 220 or 440-v., slip-ring, with drum starter and resist.	710
1	150	Allis-Chalmers, type ANY, 220 or 440-v, slip-ring, with drum starter and resistance	750
1	150	Burke, 440-v.	375
1	200	Burke, 440-v.	500
1	300	Allis-Chalmers, 220 or 440-v., new, slip-ring, constant speed	485

TRANSFORMERS

NOTE—All transformers are fully tested at our works before shipment. We will replace any transformers proving defective if returned to our works prepaid within 30 days from shipment. Terms Net 30 days to responsible parties with established rating.

PRICES do not include fuse boxes, hangers or oil.

WESTINGHOUSE, OIL—60 Cycle, Single Phase

Qu.	Kw.		Each
2	.1	220 or 440—110-v., type OD	$10.00
1	.1	2200—110-v., type OD	10.00
2	½	1100 or 2200—55, 110 or 220-v., type OD	14.00
9	1	1100 or 2200—55, 110 or 220-v., type OD	16.00
75	1½	1100 or 2200—110 or 220 volts, type OD	20.00
25	1½	1100 or 2200—110 or 220 v., type S	20.00
1	2	1100 or 2200—110 or 220 v. type S	24.00
51	2	2200—110 or 220-v., type OD	24.00
7	2½	1100 or 2200—110 or 220-v., type C	27.00
1	3	1100 or 2200—110 or 220-v., type S	30.00
9	3	2200—110 or 220-v., type S	30.00
1	3	2200—220 or 440-v., type S	30.00
5	4	1100 or 2200—110 or 220-v., type N	40.00
2	5	1100 or 2200—110 or 220-v., type S	45.00
4	4	2200—220 or 440-v., type S, new	50.00
1	7½	1100 or 2200—110 or 220-v., type OD	60.00
2	7½	2200—220 or 440-v., type S, new	70.00
1	10	2200—220 or 440-v., type S	70.00
1	10	2200—220 or 440-v., type S, new	80.00

TRANSFORMERS Continued

1	11000	—220 or 440-v., type SK	95.00
1	12½	2200—220 or 440-v., type S	80.00
1	15	11000—110 or 440-v., type SK	120.00
23	15	11000—220 or 440-v., type SK	120.00
1	50	440—110 or 220-v., type CD	240.00
9	100	11000—220 or 440-v., type SK	385.00

GENERAL ELECTRIC, TYPE H, OIL—60 CYCLE

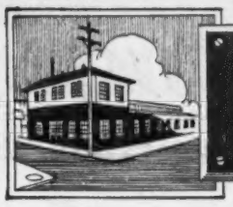
Qu.	Kw.		Each
20	.6	1100-2200—122 to 244-v	14.00
18	1	2200—110 or 220-v	16.00
24	1	2080—110-v.	16.00
20	1	2200—122 or 244-v	16.00
	1½	2080—110-v.	20.00
1	1½	1100 or 2200—55 or 110-v	20.00
1	2	1100 or 2200—110 or 220-v	24.00
4	2½	1100 or 2200—55 or 110-v	27.00
1	2½	1100 or 2200—122 or 244-volts	27.00
1	3	1100 or 2200—110 or 220 volts	30.00
7	3	1100 or 2200—122 or 244 volts	30.00
34	3	2200—110 or 220-v.	30.00
1	5	220—110-v.	45.00
3	5	3300 or 6600—122 or 244 volts	65.00
1	7½	2200—575-v.	65.00
4	10	1100 or 2200—110 or 220 v.	70.00
1	10	2200—220 or 440-v.	70.00
2	25	11500—115 or 230-v	175.00
2	25	13200—2300 or 4000-v	175.00
1	37½	11000—2300 or 4000-v	225.00
3	50	6600—220 or 440-v	275.00
3	50	13200—220 or 440-v	275.00
3	50	13800—230 or 460-v	275.00

THREE PHASE, 60 CYCLE, OIL TRANSFORMERS

Qu.	Kw.		Each
1	15	G. E., type HT, 2080—230 or 460-v.	$100.00
10	15	Westinghouse, type ST, 2080—230 or 460-v.	100.00
19	30	G. E., type HT. 2080—230 or 460-v.	160.00
2	30	Westinghouse, type ST, 2080—230 or 460-v.	160.00
1	50	Westinghouse, type ST, 2080—230 or 460-v.	240.00
1	50	G. E., type HT, 2080—230 or 460-v.	240.00

MISCELLANEOUS TRANSFORMERS

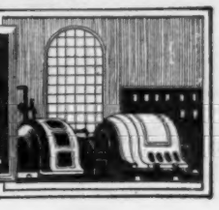
Qu.	Kw.	60 Cycle—Oil	Each
5	2½	Crocker-Wheeler, form A 2200—110 or 220-v.	30.00
8	2½	Moloney, type B, 2200—110 or 220-v.	30.00
1	3	Crocker-Wheeler, 440—110 or 220-v.	33.00
1	3	Wagner, type ST, 1100 or 2200—110 or 220-v.	33.00
1	3	Packard, type A, 1100 or 2200—110 or 220-v.	33.00
1	3	Pittsburgh, 1100 or 2200—110 or 220-v.	33.00
1	3	Adams-Bagnall, 2200—110 or 220-v.	33.00
1	3	Wagner, type M, 2200—110 or 220-v.	33.00
3	3	Pittsburgh, 2200—110 or 220-v	33.00
6	4	Wagner, type M, 2200—110 or 220-v.	40.00
1	7½	Moloney, HE, 1100 or 2200—110 or 220-v.	60.00
2	10	Moloney, HE, 1100 or 2200—110 or 220-v.	70.00
1	10	Stanley, type BO, 1100 or 2200—110 or 220-v.	70.00
4	10	Wagner, HE, 1100 or 2200—110 or 220-v.	70.00
3	10	Kuhlman, 2200—110-v.	70.00
1	10	Burke, 2200—220 or 449 volts	70.00
1	10	Ft. Wayne, type A, 6600—110 or 220-v.	95.00
1	12½	Duncan, type AD, 1100 or 2200—110 or 220-v	75.00
1	15	Stanley, type AO, 440—110-v.	90.00
5	20	Moloney, type HE, 6600—110 or 220-v.	150.00
1	25	Packard, 2200—110 or 220-v	140.00
3	25	Adams-Bagnall, 6600—110 or 220-v.	175.00
3	25	Adams-Bagnall, 13200—110 or 220-v.	175.00
1	30	Wagner, type HE, 220—110 or 220-v.	160.00
2	50	Adams & Bagnall, type E (new), 440—110 or 220 volts	250.00
2	200	Ft. Wayne, type A, form B (with 10% taps), 2200—220-v.	500.00
2	200	Ft. Wayne, type A, form B, 2200—440-v.	500.00



STEPHEN HALL & CO.

Incorporated

7th and Adams St's, Hoboken, N.J.



TELEPHONES: New York Direct Wire: Rector 3891; HOBOKEN 3750

New and Used Electrical Equipment—Condition Guaranteed—Ready to Ship

Slip Ring Motors—3-Phase, 60-Cycle

Hp.	Volts	Speed	Make	Type
400	440/220	514	General Electric	M
250	2200	600	General Electric	M
200	2200	600	General Electric	M
200	220/440	600	General Electric	M
150	2200	600	General Electric	M
150	550	600	General Electric	M
150	220/440	600	General Electric	M
150	220/440	720	Westinghouse	CW
150	550	720	Westinghouse	CW
100	2200	720	General Electric	M
100	440/220	720	General Electric	M
100	550	720	General Electric	M
75	550	720	General Electric	M
75	2200	720	General Electric	M
75	220/440	720	General Electric	M
75	440/220	1200	General Electric	MT
55	440/220	514	General Electric	M
55	550	514	General Electric	M
50	550	900	General Electric	M
50	440/220	900	General Electric	M
50	2200	900	General Electric	M
50	440/220	1200	General Electric	M
35	440/220	900	General Electric	M
35	2200	900	General Electric	M
35	550	900	General Electric	M
25	220/440	600	General Electric	M
15	220/440	720	General Electric	M

DIRECT CURRENT MOTORS

350	230	450	General Electric	MPC
200	230	800	General Electric	RC
175	115	525	Crocker-Wheeler	Interpole
125	115	500	Westinghouse	Interpole
90	115	660	Crocker-Wheeler	D
75	115	400	Crocker-Wheeler	D
75	230	850	Westinghouse	SK
50	115	750	Westinghouse	SK
50	230	525	Westinghouse	S
35	230	700	Crocker-Wheeler	I
30	110	575	Westinghouse	S
25	230	750	Crocker-Wheeler	I
15	230	1250	Allis-Chalmers	Interpole

3-Phase, 25-Cycle Motors

200	440	500	General Electric, sl. rg.	
25	220/440	750	Burke sq. ca.	
15	220/440	750	Burke sq. ca.	

Squirrel Cage—3-Phase, 60-Cycle Motors

150	220/440	720	General Electric	K
150	2200	720	General Electric	K
100	440/220	720	General Electric	K
75	2200	720	General Electric	K
75	440/220	720	General Electric	K
50	440/220	1200	General Electric	K
50	440/220	900	General Electric	K
50	550	900	Westinghouse	CS
40	440/220	900	General Electric	KT
35	550	900	General Electric	K
35	220/440	900	General Electric	K
30	220/440	900	General Electric	KT
25	220/440	900	Westinghouse	CS
25	440/220	900	General Electric	KT
25	220/440	720	General Electric	K
20	220/440	900	General Electric	K

DIRECT CURRENT GENERATORS

Kw.	Volts	Speed	Make	Type
300	250	500	General Electric	MPC
200	125	600	Crocker-Wheeler	Interpole
175	250	950	General Electric	RC
125	125	580	Westinghouse	Interpole
125	250	560	Sprague	
100	250	575	General Electric	CLB
75	250	850	General Electric	D
70	125	475	Crocker-Wheeler	D
70	250	700	Crocker-Wheeler	H
50	125	850	Westinghouse	SK
45	125	975	General Electric	CLB
40	250	875	General Electric	CLB
40	250	1100	Crocker-Wheeler	I

MOTOR GENERATOR SETS

1—325-kw., 250-volt, 514-r.p.m. Gen. Elec. MPC Interpole Generator coupled to 500 hp., 2300-volt, 3-ph., 60-cy. Gen. Elec. Form K, sq. ca. motor.

1—175-kw., 125-volt, 600-r.p.m. Crocker-Wheeler Interpole Generator, coupled to 240-hp., 2200-440-volt, 3-ph., 60-cy. General Electric synchronous motor.

1—75-kw., 125-volt, 1150-r.p.m. Westinghouse Type SK Generator connected to 112 H.P. 220/440-volt, 3-ph., 60-cy. Westinghouse Type CS Motor.

1—70-kw., 250-volt, 700-r.p.m. Crocker-Wheeler Interpole Generator, coupled to 100-hp., 2200-440-volt, 3-ph., 60-cy. squirrel cage motor.

ALTERNATING CURRENT GENERATORS

1—225-kva. Westg. 220-volt, 514-r.p.m., 2- or 3-phase, 60-cycle, R.F. Gen. with belted exciter.

1—200-kw. General Electric, 2300-volt, 600-r.p.m., 3-ph., 60-cy., Type ATB with belted exciter.

1—60-kw. Westinghouse, 220/440-volt, 900 r.p.m., 3-ph., 60-cy. Gen. with belted exciter.

1—30-kw. General Electric, 240 480-volt, 1200-r.p.m., 3-ph., 60 cy. Type ATB with belted exciter.

ENGINE GENERATOR SETS

1—75-kva., 240-volt, 277-r.p.m., 60-cy., 2- or 3-ph. Westinghouse, A. C. Generator, direct connected to 12x14 Erie Ball, side crank engine with exciter and switchboard panel.

1—30-kw., 250-volt, 300-r.p.m. Gen. Elec., D.C. Generator, dir. conn. to 10x10 Ames Engine.

1—25-kw., 125-volt, 300-r.p.m. Western Electric, D.C. Generator, dir. conn. to 8x10 Ball & Wood Engine.

1—375-kva., 240/480-volt, 240-r.p.m., 3-ph., 60-cy. Westinghouse engine type Generator, without engine.

If your requirements are not listed, write us, as we do not attempt to list our entire stock.

J.L.HEMPHILL & CO. Inc.

ELECTRICAL ENGINEERS AND EQUIPMENT

801-807 Williams St. North Bergen, N.J.

Telephones: Union 1166, 6505

A. C. MOTORS—3 PHASE, 60 CYCLE

No.	Hp.	Rpm.	Volts	Make
1	400	450	2200	G.E., synch.
2	200	900	220/440	G.E., L
1	200	720	2200/440	Cr.-Wh., sl.rg.
1	15\	514	2300/440	G.E., Form L
1	150	720	2200	Cr.-Wh., sl. rg.
1	150	600	220/440	Cr.-Wh., sq.cg.
1	100	900	220/440	Ideal sq. cg.
1	100	900	2200	G.E. synch.
1	75	690	220	Cr.-Wh., sl.rg.
1	50	900	220/440	G.E., sl. rg.
1	50	900	220/440	Westghse.,sl.rg
1	50	900	220/440	Cr.-Wh., sq.cg.
1	50	1150	220	Fairbs.-Morse
1	40	1700	220/440	Westghse.,sl.rg
1	40	720	220/440	G.E. sq. cg.
1	30	1150	220	G. E., br. new
1	25	1200	2200	G. E., KT
1	25	1200	220/440	Allis Chal.
1	20	900	220/440	G.E., sq.cg.
3	20	1200	220/440	G.E., sq. cg.
1	20	860	220/440	Otis sl. rg.
3	15	1200	220/440	G.E., K
1	7½	1200	220/440	Allis Chal.
2	5	1800	220/440	G.E. and Westghse.
1	3	1200	220/440	G.E.
1	3¼	600/1800	440	G.E. new var. speed
2	3	900	220/440	KT vertical
6	2	1800	220/440	G.E.

2-Phase Motors on request

A. C. MOTORS—3-PHASE, 25-CYCLE

1	150	480	2200	Westg., sl.rg.
1	15	750	220/440	G.E., sq. ca.

D. C. GENERATORS—250 VOLT

1	150	880	Cr.-Wh. Int.
1	100	580	Westghse.
1	75	550	G. E.
1	50	600	Westghse.
1	30	1000	Westghse.
2	15	900	Allis-Chal.

Smaller sizes on request.

D. C. GENERATORS—125 VOLT

5, 10, 20, 22, 35, 50, 75 Kw.

D. C. MOTORS—230 VOLT

No.	Hp.	Rpm.	Make
1	75	775	Cr.-Wh.C.C.D.
2	100	500	Diehl
1	90	470	G. E., C.L.
2	75	750	Diehl
1	55	675	Diehl
1	50	200	Diehl
1	35	700	Cr.-Wh.
1	25	1300	Sprague
3	25	600/1200	Allis-Chal.
1	20	650	G. E.
1	20	700	Holtzer Cabot
1	15	750	Holtzer Cabot
1	15	1250	Allis-Chal.
1	10	1200	Allis-Chal.
1	10	850	G. E.
3	10	275/1575	Allis-Chal.
1	7.5	625	G. E.
1	3	1150	G. E., new
1	½	375	Holtzer Cabot

D. C. MOTORS—125 VOLT

1	80	750	G. E., D.L.C.
1	35	875	West.
1	20	650	Allis-Chal.
1	15	775	SK, Westg.
1	5	700	Diehl
1	5	385	G.E. vert.
3	3	1100	G. E.
2	3	1700	G. E.

A. C. GENERATORS

No.	Kw.	Rpm.	Volts	Make
1	300	450	2300	G. E., P
1	100	900	2200	West. G
1	75	900	2200	G. E.
1	75	600	2200	West.
1	50	1200	2200	West. G

TURBINES

1—475-kva., 3600-r.p.m., 3-ph., 60-cy., 220/440 v., Westinghouse, non-condensing, with direct connected exciter.

1—150-kw. DeLaval, Crocker-Wheeler, 3-wire 125/250-v., Complete, operated one year.

ENGINE GENERATOR SETS

3—200-kw., 250-v., D.C. Gen., connected to Allis-Chal., 18x36 right-hand Corliss Engine.

1—150-kw. Bullock 120 V. D. C. generator 150 rev. dir. conn. to 17 x 24 Fitchburgh engine.

1—150-kw., 220 r.p.m. 125/250-v., G. E. 3-wire engine type generator.

1—100-kw., 125-v., 2-wire, D.C. Westinghouse R.H. gen. conn. to Harrisburg std. tand cud., 11x18x13 engine, 275-r.p.m., complete

1—75-kva. General Electric, 257 r.p.m., 3-ph. 60-cy., 440/2300-v., dir. conn. engine generator sets.

1—New 24-kw., G. E. 60-cy., 3-ph., 2300-v. Generator, dir. con. 45 hp. Mianus improved Diesel engine, complete with switchboard,

MOTOR GENERATOR SETS

300-kw., 720-rev., 125/250-v., 3-unit set consisting of (2) 150-kw., 125-v., D.C., G. E gen. (1) 450-hp., 440/2300-v. motor.

300-kw. 500-v., 3-ph., 60-cy., 2300-v., Westinghouse syn. motor generator set.

250-kw., 450-250v. Al-Ch. Gen. 375-hp. 2300 v. G.E. Syn. Motor.

150-kw, 860 r.p.m. 250-v. Cr.-Wh., with 225-hp., 3-ph, 60-cy. 220/440-v. wound rotor Ind. Motor.

100-kw., 250-v. Gen., 900-r.p.m., 220/440-v. syn. motor.

50-kw., 720-rev., 250-v. Gen., 75-hp., 220/440-v. motor.

10-20-25-40-kw., 125-v. Exciter Sets.

5-kw. Balancer Set.

TRANSFORMERS

3—75-kva. General Electric Type H, Form KS, 60-cy., 440-v. 110/220-v.

1—3-ph., oil-insulated, self-cooled, O.D. type 5000-kva., 44,000-v. delta, 22,000-v. Y Now connected 22,000-v. delta, high side—11,000-v. low side.

4—Type H, 150-kva., 50-cy., 8000/2300-v., G. E form KDD, brand new.

Power Machinery Exchange

A. C. Units

1 Montgomery Street, Jersey City, N.J.

A.C. Generators

3-Phase, 60-Cycle

Kva.	Generator	Engine
625	Gen. Elec.	Curtis Turbine
500	Westghse.	Parsons turbine
375	Gen. Elec.	Curtis Turbine
315	Ridgway	Ridgway
300	Allis-Chal.	Skinner
250	Allis-Chal.	Allis-Chal. Corliss
200	Westghse.	Erie Ball, 4-valve
175	Allis-Chal.	Allis-Chal
150	Gen. Elec.	Skinner Unaflow
120	Gen. Elec.	Hamilton, 4-valve
100	Ridgway	Ridgway
100	Gen. Elec.	Harrisburg, 4 valve
90	Gen. Elec.	Ames Unaflow
90	Gen. Elec.	Chuse, 4-valve
75	Ridgway	Ridgway
75	Gen. Elec.	Skinner
75	Gen. Elec.	Erie, 4-valve
70	Westghse.	Harrisburg
50	Gen. Elec.	Skinner
35	Gen. Elec.	Skinner Unaflow

Kva.	Make	Speed
625	Allis-Chal.	257
550	Allis-Chal.	200
540	Gen. Elec.	360
500	Gen. Elec. 3 bearing	360
450 (2)	Gen. Elec.	200
400	Gen. Elec. 3 bearing	360
360	Westghse.	360
300	Gen. Elec.	360
250	Westghse.	600
200	Gen. Elec.	600
150	Gen. Elec.	600
100	Gen. Elec.	900
75	Gen. Elec.	900
56	Gen. Elec.	1200
45	Gen. Elec.	1200

UNAFLOW UNIT

240 kva. Gen. Elec. 3 ph., 60 cy., dir. con. 17x20 Ames Unaflow Engine. One year service. $5500.

TURBINE UNIT

1875 kva. Allis-Chalmers 2 or 3 ph., 60 cy., with surface condenser and all equipment. Immediate delivery. $17,000

BOILERS

Four 315 H.P. Stirling A.S.M.E. code, 180 lb. pressure, with Jones Stokers, complete $10,000.

4 VALVE UNIT

125 kva. General Electric 3-ph., 60-cy., Alternator, dir. con. 17x18-in. Harrisburg late type, 4-valve engine. Two years service. Practically new; $2500.

CORLISS UNIT

225 kva. Wghse, 3 ph., 60 cy., dir. con. 16x24 Monarch Heavy Duty Engine. $3500.

3 WIRE UNITS

2—200 kw. Westinghouse, 250-125 v., dir. con. Monarch Heavy Duty Corliss Engine; $3500. 300 kw. Ditto; $4750.

Boilers, Engines, Motors and Generators All sizes. Write for information

4 VALVE UNIT

312 kva., Gen. Elec., 3 ph., 60 cy., dir. con. 19x20 Erie Ball 4 valve Engine, $5500.
125 kva., Gen. Elec., 3 ph., 60 cy., dir. con. 19x20 Erie Ball 4 valve Engine, $2500.

BLEEDER TYPE TURBINE

625 kva. Westinghouse, 3 ph., 60 cy., A.C., with exciter, switchboard and condenser. Instant shipment, $9,000.

Serviceable Power Equipment **WE BUY** *What Have You to Offer?*

GOOD USABLE EQUIPMENT

PRICED TO MOVE AT ONCE

All this equipment was replaced by reason of changing to 60 cycle A.C. in formerly D.C. and 25 cycle Districts

BOILERS—FIRE TUBE

No.	H.P.	Make	Pressur
1	150	Murray	150 lb.e
4	125	Murray, Springfield Lyons & Penn	
3	1—100	Frost	
	1— 90	Murray	
	1— 80	Penna.	

BLOWERS

2—Sturtevant exhausters No.5 ½ type A.10,000 c.ft

CHOKE COILS

3—G.E. 4600 volt on marble slabs
6—G.E. 660 volt on marble slabs

CONDENSERS

Worthington 7,000 sq.ft.
Wheeler 8,000 sq.ft.
Wheeler 16,000 sq.ft.

ENGINES

S	Make	H.P.
Murray	Standard Corliss	75
Murray	Standard Corliss	100
Murray	Standard Corliss	161
Fairbanks-Morse	50 oilengine	
Fairbanks-Morse	25 oil engine	

EXCITERS

75 K.W. Turbo exciter DeLaval
35 K.W. Turbo exciter Curtis

FANS—D. C.

Stationary — oscillating — exhaust — ceiling G. E., Westinghouse and other makes

No.	Size, In.	No.	Size, In.
6	6	6	10
27	8	188	12
27	8	153	16
11	56 in. ceiling fans		
Exhausts			
2	24	51	56
1		DeVilbiss	

CABLE

No. 6	2300 volt, 3 cond. on hand 1,600 ft.
No. 2	2300 volt, 3 cond. on hand 3,000 ft.
No. 1/0	6600 volt, 3 cond. on hand 190 ft.
No. 2/0	6600 volt, 3 cond. on hand 967 ft.
No 3/0	6600 volt, 3 cond. on hand 7,000 ft.
No. 4	13,200 volt, 3 cond. on hand 3,800 ft.

FREQUENCY CHANGERS

25 to 60 Cycle

150 Kva. General Electric.
Generator, 2300 volt, 62 ½ cycle.
Motor, 2300 volt, 25 cycle.
3 500 kva., General Electric.
Generator, 2400 volt, 62 ½ cycle.
Motor, 6600 volt, 25 cycle.
1000 kva. General Electric.
Generator, 2400 volt, 62 ½ cycle.
Motor, 6600 volt, 25 cycle.
1250 kva. General Electric.
Generator, 2400 volt, 62 ½ cycle.
Motor, 6600 volt, 25 cycle.

ROTARY CONVERTERS

1—750 KW., 275 volt, 250 RPM., 25 cycle, type HC., 1—G.E. transformer, 825 KVA., 3/6 phase, 6600/186 volts.
1—1500 KW., 275 volts, 214 RPM., 25 cycle type HC., 3—Maloney single phase, transformers, 750 KVA., 13,200—460/220 volt, 25 cycle.
1—1500 KW., 225-275 volts, 214 RPM., 25 cycle, type HCB., 1—G. E. transformer, 1650 KVA., 3-6 phase, 6600-186 volts
1—2000 KW., 225/300 D.C. volt, 300 RPM., 25 cycle type HCC., 1—G.E. transformer, 2200 KVA., 3-6 phase, 6930-195 volts.
2—200 KW., 125 volt, D.C. transformer for 25 cycle side.
All above with equipment necessary for operation.

ENGINE GENERATORS

75 K.W. Warren Electric, 3 phase, 2300 volt, 60 cycle, generator direct connected to Erie City steam engine
18.5 K.W. Engberg, 3 phase, 240 volt, 60 cycle, direct connected to Engberg vertical steam engine
25 K.W. General Electric generator 2300 volt, 3 phase, direct connected to 4 cylinder gasoline engine

GENERATORS

180 K.W. Westinghouse	2300 volt, 3 ph., 60 cy.	
90 K.W. Westinghouse	2080 volt, 3 ph., 60 cy.	
75 K.W. Westinghouse	2200 volt, 3 ph., 60 cy.	
75 K.W. Elec. Mach.	2300 volt, 3 ph., 60 cy.	
50 K.W. Westinghouse	2300 volt, 3 ph., 60 cy.	
45 K.W. Gen. Elec.	125 volt, D.C.	
30 K.W. Fair.-Morse	2300 volt, 3 ph., 60 cy.	
25 K.W. Gen. Elec.	2300 volt, 3 ph., 60 cy.	
15 K.W. Fair.-Morse	2300 volt, 3 ph., 60 cy.	

INDUCTION REGULATORS

No.	Make	Amps.	Phase	Voltage
1	Westinghouse	150	1	2200
1	Gen. Elec.	150		2200
1	Gen. Elec.	150	3	2200

LIGHTNING ARRESTERS

No.	Make	Type	Volts
2	Gen. Elec.	H	6900
1	Gen. Elec.	H	4600
1	Gen. Elec.	H	9200

METERS

No. 116—Twenty-five cycle watthour meters, General Electric and Westinghouse, two and three wire, single and three phase, 5 to 1000 amps.
No. 814—D.C. watthour meters, Gen. Elec. and Westinghouse, two and three wire, 5 to 500 amps., type M.

D. C. AMMETERS

No. 32—Thompson, Gen. Elec. and Weston from 0 to 10 amps. and 0 to 12000 amps.

This Is Not a Complete List of Available Equipment.

NOTE: As we are constantly changing over more A.C. districts it will pay you to let us know your needs.

Address all inquiries to W. C. Blair, Industrial Engineer.

KANSAS CITY POWER & LIGHT CO., 1332 Grand Ave., Kansas City, Mo.

MOTORS—TRANSFORMERS

AT ATTRACTIVE PRICES

MOTORS—3-PH. 60-CYC. 220/440-V.

Qu.	Hp.	Speed	Description		Type
5	10	1200	General Electric	KT.	Squirrel Cage
2	10	1200	Lincoln	C.	Squirrel Cage
1	10	1200	Allis-Chalmers	.....	Squirrel Cage
12	10	900	General Electric	KT.	Squirrel Cage
52	10	720	General Electric	KT.	Squirrel Cage
1	10	680	General Electric	I-M.	Slip Ring
1	10	550–1720	Watson	KH.	Multi-Speed
1	15	1700	Westinghouse	CCL.	Squirrel Cage
1	15	1200	Fairbanks-Morse	B.	Squirrel Cage
3	15	1200	General Electric	KT.	Squirrel Cage
1	15	1200	Allis-Chalmers	.....	Squirrel Cage
1	15	1200	Westinghouse	CS.	Squirrel Cage
1	15	1200	Robbins & Myers	K.	Squirrel Cage
1	15	900	Westinghouse	CS.	Squirrel Cage
2	15	850	Crocker-Wheeler	.....	Squirrel Cage
1	15	900	General Electric	KT.	Squirrel Cage
1	15	900	General Electric	I-K	Squirrel Cage
1	15	720	General Electric	I-K	Squirrel Cage
1	15	680	General Electric	I-M	Slip Ring
1	15	600	Burke	EM.	Squirrel Cage
1	20	1800	Westinghouse	CCL.	Squirrel Cage
1	20	1200	Fairbanks-Morse	.....	Slip Ring
1	20	1200	Fairbanks-Morse	KBV.	Wound Rotor
1	20	1200	General Electric	KT.	Squirrel Cage
2	20	1200	Westinghouse	CS.	Squirrel Cage
10	20	900	General Electric	KT.	Squirrel Cage
1	20	900	Bullock	.....	Squirrel Cage
1	20	860	Westinghouse	CS.	Squirrel Cage
2	20	900	Lincoln	C.	Squirrel Cage
1	20	720	Westinghouse	CS.	Squirrel Cage
2	25	1200	General Electric	KT.	Squirrel Cage
1	25	900	General Electric	I-M	Slip Ring
3	25	900	General Electric	KT.	Squirrel Cage
1	25	900	Lincoln	C.	Squirrel Cage
1	25	840	Westinghouse	F.	Slip Ring
1	30	900	General Electric	I-M	Slip Ring
1	30	850	Westinghouse	CS.	Squirrel Cage
2	30	850	Westinghouse	CCL.	Squirrel Cage

MOTORS—3-PH. 60-CYC. 220/440-V. (Cont'd)

Qu.	Hp.	Speed	Description		Type
1	30	900	General Electric	KT	Squirrel Cage
1	35	1200	General Electric	I-L	Wound Rotor
1	37½	1150	General Electric	ITC	Slip Ring
1	40	900	General Electric	I-M	Slip Ring
1	40	850	General Electric	KT.	Squirrel Cage
1	50	1150	Lincoln	C.	Squirrel Cage
1	50	1150	General Electric	ITC.	Slip Ring
1	50	870	Fairbanks-Morse	.....	Squirrel Cage
1	50	900	General Electric	KT.	Squirrel Cage
1	60	900	Allis-Chalmers	.....	Squirrel Cage
1	75	850	Westinghouse	CCL.	Squirrel Cage
1	75	580	Westinghouse	CW.	Slip Ring
2	100	1800	Lincoln (2200 V.)	.....	Squirrel Cage
1	100	850	Westinghouse	CS.	Squirrel Cage
1	100	850	Westinghouse	CCL.	Squirrel Cage
2	150	850	General Electric	I.	Slip Ring
1	150	850	General Electric	I-K	Squirrel Cage
1	150	600	General Electric (2200 V.)	I.	Slip Ring
1	150	600	General Electric (2200 V.)	I-L.	Wound Rotor
1	200	600	Gen. Elec. (220–440 V.)	.....	Slip Ring
1	250	600	Allis-Chalmers (2200 V.)	.....	Slip Ring
1	400	720	General Electric (2200 V.)	.....	Slip Ring

TRANSFORMERS

No.	Kva.	Voltage	Description	
3	250	2300/230/460	General Electric	A-L
3	150	2200/220/440	General Electric	H-KDH
1	50	2200/220/440	General Electric	H-K
1	15	2300/230/460	Pittsburgh	.....
2	15	550/110/220	General Electric	H
1	15	2300/230/460	Westinghouse	.....
1	10	2300/230/460	Pittsburgh	.....
3	7½	440/110/220	General Electric	H
1	5	440/110/220	Westinghouse	S
1	5	440/110/220	Pittsburg	.....
6	5	440/110/220	Crocker-Wheeler	.....
10	5	440/110/220	General Electric	H

We also have a large stock of D. C. Motors, Motor Generator Sets, Engine Generator Sets, etc.
May we send you our complete stock list?

123-125 N. 3rd St. R. SCHEINERT CO. Philadelphia, Pa.

HONESTLY REBUILT

SYNCHRONOUS MOTOR GENERATOR SETS

GUARANTEED

1—50-kw., 250-v., D.C. Gen'l. Elect. Generator, 60-kva., 3-ph., 60-cy., 2300-volt, 1200 r.p.m., Synch. Motor. A.C. and D.C. Switchboards

1—75-kw., 125-v., D.C. Allis-Chalmers, 3-ph., 60-cy., 2300-v., 900 r.p.m. Synchronous Motor Generator Set. A.C. and D.C. Switchboards.

1—100-kw., 125-v., D.C. Allis-Chalmers 3-ph., 60-cy., 2300-volt, 900 r.p.m., Synchronous Motor Generator Set. A.C. and D.C. Switchboards

2—150-kw., 250/275-v., D.C. Westgh., 3-ph., 60-cy., 2300-volt, 900 r.p.m., Syn. Motor Generator Sets. A.C. and D.C. Switchboards.

1—300-kw., 250-volt, D.C. Willey Gen'l. Elect., 3-ph., 60-cy., 2300-volt, 450 r.p.m., Synch. Motor Generator Set. Complete equipment.

GUARANTEED

REBUILT-IN-OUR-SHOPS

Operating Condition Equal to New.
Fully Guaranteed.

Miller-Owen Electric Co., Inc.

Pittsburgh, Penna.

Ask for Stock On Hand Bulletin.

ELECTRICAL MACHINERY

---

60 CYCLE TRANSFORMERS

2—2500-kva. G. E., 3 ph., 30,000-60,000 v. prim., 14,500 v. secy.
1—1500-kw. G. E., 3 ph., 13,200 v. prim., 6600-2200-500 v. secy.
2—1000-kw. Westghse., 33,000 v. prim., 2300 v., Scott conn. secy.
3—1000-kva. Westghse., single ph., 6600 v. prim., 2300 v. secy.
3— 500-kva. G. E., Type H, 2200 v. prim., 550 v. secy.
3— 500-kva. Westghse., single ph., 6600 v. prim., 2200 v. secy.
4— 400-kva. Pittsburgh, 6600 v. prim., 440-220 v. secy.
3— 333-kva. G.E. Type A, form L, single ph., 11500 v. prim., 230-460 v. secy.
2— 250-kw. G.E., Type H, 13200 v. prim., 2300 v. secy., Scott conn.
3— 250-kva. Pittsburgh 13200 v. prim., 2300 v. secy.
3— 200-kva. Westghse., 6400 v. prim., 2200 v. secy.
3— 200-kva. G. E., Type H, 2200 v. prim., 244-488 v. secy.
3— 185-kva. Westghse., 2400 v. prim., 422 v. secy.
3— 150-kva. G. E., 6600-6300-6000 v. prim., 120-240 v. secy.
3— 150-kva. Pittsburgh, 11,000 v. prim., 155-186 v. secy.
3— 100-kva. G. E., Type H, 6600 v. prim., 605-545 v. secy.
3— 100-kva. G. E., 2300 v. prim., 220-110 v. secy.
3— 100-kva. G.E., Type H, 13800 v. prim., 230-460 v. secy.
2— 100-kw. Westghse., Type S, 440 v. prim., 220 v. secy.
4— 100-kva. Pittsburgh, 2200 v. prim., 110-220 v. secy.
2— 100-kw. G. E., Type H, 6600 v. prim., 373-385-397 v. secy.
3— 100-kva. G. E., Type H, 34,600-60,000 v. prim., 440-220 v. secy.
3— 100-kva. G. E., Type H, 34,600-60,000 v. prim., 2300 v. secy.
2— 75-kva. G. E., Type H, 2000 v. prim., 575 v. secy.
3— 75-kva. G. E., Type H, 11,000-9900 v. prim., 6600 v. secy.
3— 75-kva. Pittsburgh, 2200 v. prim., 110-220 v. secy.
1— 50-kva. G. E., Type H, 550 v. prim., 220-110 v. secy.
1— 40-kva. Westghse., 7600 v. prim., 440 v. secy.
1— 40-kva. G. E., Type H, 550 v. prim., 220-110 v. secy.
3— 37½-kva. Westghse., 2200 v. prim., 575 v. secy.
1— 25-kva. Kuhlman, 3 ph., 2400-4800 v. prim., 480 v. secy.
9— 25-kva. Pittsburgh, 2200 v. prim., 220-440 v. secy.
2— 25-kva. G. E., Type H, 2200 v. prim., 110-220 v. secy.
2— 20-kva. G. E., Type H, 550 v. prim., 220-110 v. secy.
9— 20-kva. G. E., 1200-2400 v. prim., 120-240 v. secy.
4— 15-kva. G. E., 1200-2400 v. prim., 120-240 v. secy.
13— 10-kva. G. E., 1200-2400 v. prim., 120-240 v. secy.
5— 10-kva. Westghse., 1200-2400 v. prim., 120-240 v. secy.

25 CYCLE TRANSFORMERS

2—2500-kva. G. E., 3 ph., 30,000-60,000 v. prim., 14,500 v. secy.
1—1500-kva. G. E., 13,200 v. prim., 6600 v. secy.
6— 500-kva. Westghse., 13,200 v. prim., 6600 v. secy.
6— 100-kw. G. E., 13,200-11,880 v. prim., 185-370 v. secy.
3— 75-kva. G. E., Type H, 12,500-11,750 v. prim., 678 v. secy.

If you do not find transformers of size and characteristics required, write us and we will quote you from our available list. We also have on hand complete equipment from a transformer sub-station, from 33,000 volts to 13,200 and 2200 volts, including lightning arresters, disconnecting switches, panelboards and instruments.

ARCHER & BALDWIN, INC.

114-118 Liberty St., New York City

Telephone 4337-4338 Rector

Send for description and prices

SAVE HALF YOUR MOTOR COST

You can save nearly 50% of the price of new equipment by buying good used apparatus from us. A motor or dynamo reconditioned at our shops can be honestly classed as equal to new. We put our 18 years' experience into every job and guarantee each rebuilt motor to be free from electrical and mechanical defects for one year.

3 Phase, 60 Cycle, 220/440 Volts

Qu.	Hp.	Make	Type	Speed
1	75	G.E.	KT	900
1	75	G.E.	KT	720
1	50	G. E. (25 cyc.)	KT	720
1	50	G.E.	KT	860
1	40	G.E.	KT	1200
1	35	G.E. (Fm L)	L	1200
1	30	G.E.	KT	1800
1	30	G.E.	KT	1200
1	30	G.E. (New)	KT	900
1	25	G.E.	KT	1800
1	25	West	CS	1800
3	25	G.E. (New)	KT	1200
1	25	G.E.	KT	900
1	25	Fbks-M.	KBV	900
1	25	Allis-Ch.	.....	1200
1	25	Fbks-M.	.....	900
2	25	West.	C	1200
3	20	West.	C	1200
2	20	West.	C	900
1	20	G.E.	KT	1800
2	20	G.E. (New)	KT	1200
2	20	Allis-Ch.	.....	1200
1	20	G.E. (Form L)	L	1200

Also 150 smaller sizes down to ¼ hp.

2 Phase, 60 Cycle, 220/440 Volts

Qu.	Hp.	Make	Type	Speed
1	50	Cr-Wh.	.....	900
1	50	West.	CCL	900
1	50	G.E.	KQ	900
1	50	G.E.	KQ	1200
1	40	G.E.	KQ	1200
1	30	G.E.	KQ	1800
1	25	West.	C	1200
1	25	West.	CS	1200
2	25	West.	CS	900
1	25	G.E.	KQ	1800
1	20	West.	CCL	1800
2	20	G.E.	KQ	1800
1	20	Cr-Wh.	.....	1200
2	20	G.E.	KQ	1200
1	20	West.	CS.	1200
1	20	G.E. (Fm. L)	L	900
1	20	West.	C	900

Also 145 smaller sizes down to ¼ hp.

SLIP RING

3 Phase, 60 Cycle, 220/440 Volts

Qu.	Hp.	Make	Type	Speed
1	300	A-C. motor only	ANY	900
1	250	A.C., 2200 v. new	ANY	....
		Three Bearing		
1	200	G.E.	I-M	600
1	200	G.E. (2 ph.)	MQ	590
1	150	G.E.	I-M	720
1	75	G.E. (3 bear.)	I-M	514
1	75	West.	HF	720
1	75	G.E.	I-M	900
2	50	G.E.	MT	900
1	40	G.E. (25 cy.)	MT	750
1	37	G.E.	ITC	600
1	30	G.E.,	ITC	720
1	25	West. (2 ph.)	HF	1800
1	20	Wagner (2 ph.)	BR	1800
4	20	El. Mchy.(New)	.....	1200
1	20	West.	HF	900
1	10	G.E. (New)	MT	1800
1	10	G.E. (550 v.)	MT	1800
2	7½	G.E. (New)	MT	1800
2	7½	Lincoln, (550 v.)	IXF	1800
1	5	G.E. (New)	MT	1800
2	5	G.E.	MT	1800
2	3	G.E. (New)	MT	1800
1	3	G.E. (25 cy.)	MT	750
1	1	Wagner (2 ph.)	BR	1200

All complete with pulleys, bases and controllers.

DIRECT CURRENT—230 VOLTS

Qu.	Hp.	Make	Type	Speed
1	150	West.	M	500
1	100	C. & C.	SL	400
1	100	West.	S	775
1	90	G.E.	CL	450
1	75	Sprague	LC	580/850
1	75	C. & C.	.....	400
1	50	G.E.	D.LC.	1100
1	50	G.E.	RC	1700
1	50	West.	IS	525
1	55	Allis-Ch.	.....	550
1	40	G.E.	RC	1100
1	40	C. & C. Interpole	SLS	950
1	40	West.	S	550
1	40	West.	SK	775
1	40	Sprague	D	560/700
1	35	West.	SK	1150

DIRECT CURRENT—230 Volts—Cont'd

1	35	Cr-Wh.	CM	700
1	35	G.E.	CL	575
1	35	G.E.	CL	780
1	30	Sprague	D	825
1	30	Sprague	D	750
1	30	G.E.	DLC	1100
1	25	G.E.	RC	775
1	25	Sprague	D	600
2	20	West.	S	650
2	20	C.&C. (Opentype)	.....	1200
1	20	G.E.	CE	1100
1	20	Cr-Wh.	CCM	775
1	20	G.E.	RC	800
1	20	G.E.	RC	1100
1	20	G.E.	RLC	400/1200
1	20	G.E.	RLC	300/1200
1	20	G.E.	CL	600/1200
1	20	G.E.	CVC	975

Also 111 smaller sizes down to 1/6 hp.

DIRECT CURRENT—110/125 VOLTS

Qu.	Hp.	Make	Type	Speed
1	40	Diehl	K	1300
1	20	Sprague	LC	1500
2	15	Electro Dynamic	.....	1700
1	15	Watson	.....	1300
1	15	Cr-Wh.	CCM	1070
1	13	Cr-Wh.	CCM	1090
1	13	West.	S	875
1	10	G.E.	CVC	700
1	10	West.	S	1600
1	10	Northern	.....	1100
1	10	Diehl	.....	1000

Also hundreds of smaller sizes down to 1/30 hp.

New Stock List Just Issued

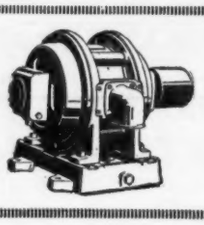
L. J. LAND

207 Centre St.
NEW YORK
Phone: Canal 9310

USED DC METERS

4—5 amp., 110 v., Type "C" Thomson Meters.
76—5 amp., 110 v., Type "E" DC Duncan two-wire meters.
115—5 amp., 110 v., Type "D" DC Sangamo meters.
2—5 amp., 100-125 v. DC two-wire Type "E" Duncan meters.
4—5 amp., 110 v., Willis Straight line—glass box meters.
3—5 amp., 100-110 v., Thomson Recording meters.
4—5 amp., 220 v., two-wire Duncan meters.
1—10 amp., 110 v., Willis straight line—glass box meter.
13—10 amp., 110 v. DC Type "E" Duncan two-wire meters.
97—10 amp., 110 v. DC Type D-5 Sangamo meters.
2—10 amp., 220 v. DC Type D-5 Sangamo meters.
2—10 amp., 220-225 v. DC Type "E" Duncan two-wire meters.
1—15 amp., 100-125 v. DC Type "E" Duncan two-wire meter.
3—20 amp., 110 v. DC Type D Sangamo meters.
1—25 amp., 110 v. DC Type D-5 Sangamo meter.
2—40 amp., 110 v. DC Type "D" Sangamo meters.
1—50 amp., 220 v. DC Type D-5 Sangamo meter.
1—150 amp., 220 v. DC Type D-5 Sangamo meter.

THE McGRAW CO., Sioux City, Iowa



IF, in purchasing electrical equipment, you demand reliable guaranteed rebuilt machines at a price that saves you money, and need the equipment immediately write

The FUERST-FRIEDMAN Co.
Cleveland, Ohio
Over 8500 electric motors, generators and transformers in stock.

TURBINE BARGAINS

2000 kw. General Electric
1000 kw. Allis-Chalmers

3 phase, 60 cycle, 1800 rev. 2300 v., or 4000 v., each with Alberger surface condenser, pumps, etc., etc.
Can be seen in operation. Immediate delivery. Genuine bargain to quick buyer. Telegraph inquiries at our expense.

Other Bargains
J. V. WALLACE CO., INC.
"America's Electrical Clearing House"
11 Wall St., Schenectady, N. Y.

3 PHASE 25 CYCLE MOTORS

1—150 hp., 485 r.p.m., 440 v., Westinghouse (slip ring).
1—150 hp., 490 r.p.m., 440 v., Allis-Chalmers.
1—50 hp., 750 r.p.m., 440 v., General Electric.
1—40 hp., 750 r.p.m., 440 v., Fairbanks-Morse (slip ring).
1—30 hp., 750 r.p.m., 440 v., Fairbanks-Morse.
2—25 hp., 750 r.p.m., 440 v., G. E. and Westinghouse.
1—20 hp., 730 r.p.m., 220 v., Westinghouse.

Many smaller sizes. Low Prices. All guaranteed

V. M. NUSSBAUM & CO., Fort Wayne, Ind.

WHAT HAVE YOU

FOR SALE
FOR RENT
FOR EXCHANGE
?

Up-to-date buyers in this industry watch the Second-Hand Equipment pages of this paper.

"Opportunity" Advertising:

Think *"SEARCHLIGHT"* First!

0098

TURBINES

3—250 kva. unused, 220-v., 3-ph., 60-cy., 3600 r.p.m., Allis-Chalmers to a Moore condensing type turbine and direct connected exciter.

1—300 kva., 440-v., 3-ph., 60-cy., 3600 r.p.m., Westinghouse generator to a Westinghouse-Parsons steam turbine, with Wheeler Condenser and Engineering Co.'s Admiralty type condenser; also Blue Vermont marble panel for generator with three 600 amp. ammeters; one 100 amp. D.C. ammeter; one 600 v. A.C. voltmeter on swinging bracket with exciter switch, main switch and rheostat.

1—300 kw. Westinghouse direct current generator, Serial No. 1821519, 900 r.p.m., 500 amp., 550/600 v., direct connected to No. 3292 Westinghouse steam turbine, 6000 r.p.m., non-condensing. This turbo-generator could be used for belt drive by using pulley in place of generator. A new alternating current generator could be bought to replace the direct current machine and make a cheap and very fine unit.

1—375 kva. Westinghouse generator, 3 ph., 60 cy., 2300 v., 900 r.p.m., connected through reduction gear to Westinghouse frame 3-EHNC turbine, condensing, with switchboard.

1—625 kva. Westinghouse generator, 3 ph., 60 cy., 2300 v., 900 r.p.m., connected through reduction gear to a frame 6-EHC Westinghouse turbine with Westinghouse-LeBlanc turbine driven condenser, with switchboard.

1—2500 kw., 3125 kva., 2300-v., 3-ph., 60-cy., 80% P. F., 1800 r.p.m., type ATB, General Electric horizontal type Turbo-generator with Westinghouse-LeBlanc condenser. An exceptionally fine operating unit. New cost about $65,000.00.

CONDENSER

1—Wheeler 14—a two pass surface condenser containing 848 sq. ft. of cooling surface made up of ⅝ in.—OD No. 18 BWG brass tubes 8 ft. long, expanded at both ends in rolled Muntz metal tube sheets with corset lace packing and brass screw ferrules.
1—Wheeler 8x14x2½x12 combined vacuum and tail pump.
1—10-in. vertical water sealed automatic exhaust relief valve.

George SACHSENMAIER Co.
930 North Third St.
Philadelphia, Pa.

Bargain Before Moving

MOTOR GENERATOR SET

100 kw. General Electric, 150-hp. Synchronous Motor, 440-220 v. A.C., 3 ph., 60 cy.; direct connected to 100 kw. direct current generator, volts 250-270 at speed of 1200 r.p.m. Complete with three panel instrument boards with full set of meters, rheostats, and switches. Practically a new outfit at less than one-half of the original cost. **Price, $2500.00.**

TWO ARC WELDER

Wilson Welder. Type DA; 15-hp. A.C., 3-ph., 220-v., 60-cy. Motor, direct connected to Ridgeway 10½ kw., 35-v., 300 amp. generator, speed, 1750; also 15-hp., 230-v. D.C. Ridgeway Motor as spare to make this a D.C. outfit. Complete with two panel boards, switches, controls and welding tips. In A-1 condition. **Price, $900.00.**

LOUIS E. EMERMAN & COMPANY
1761 Elston Avenue, Chicago, Ill.

Power Plant Equipment

2500-kw., G. E. Turbine, 3-60-2300-v. Condenser.
1—750-kw., Syn. G. E. Converter, 240-120-v. Panels, Transformers, 3-60-13,800 or 6900 v.
1—500-kw., Syn., G. E. Converter, 240-120-v. Panels, Transformers, 3-60-13,800 or 6900 v.
1—775-kva., Westinghouse-Hamilton Engine Set, 3-60-480 v.
1—NEW 500-kw. Allis-Chalmers Turbo, 3-60-480 v.
1—250-kw., 125-v., Diehl Generator, D.C. to Kerr Turbine.
1—150-hp., Gen. Elec. 3-60-220-v. Motor Generator Set, 250-125 v.
1— 75-kw., Allis-Chalmers-Skinner Engine Set, 250 v.
6—333-kva., Pittsburgh, single ph., 60 cy., Transformers, primary 13,200 v., secondary 2300 v.
3—200-kva., Packard, single ph., 60 cy., Transformers, primary 13,200 v., secondary 575 v.
15—Panels, switchboard equipment, all purposes.
4—72-in.x19-ft., 6-in., HRT. Mass. Std. Boilers, breeching, all fittings, pumps, feed water heater, making complete heating plant, serving 60,000-sq. ft. radiation.
NEW 25-Ton Baldwin, 4-Wheel, Standard Gauge, Gasoline Locomotive.

COMPRESSORS to 5000 ft.—Steam and Electric

A. LEE ELLIS, 10 High St., Boston, Mass.
Telephone: Congress 4597

For Sale for the Account of the Owner

A. C. GENERATORS

1—200 Kw. G. E. 60 cy., 3 ph., 2300 v., 600 R.P.M. (4.7)†
*1—400 Kva. G. E. 60 cy., 3 ph., 480 v., 164 R.P.M. (4.1)
1—450 Kva. G. E. 60 cy., 3 ph., 2300 v., 300 R.P.M. (14.26)
1—900 Kva. G. E. 60 cy., 3 ph., 2300 v., 240 R.P.M. (14.26)

A. C. GENERATOR SETS

1—150 Kw. C. W. 60 cy., 3 ph., 440 v. Ames Engine (14.23)
1—200 Kw. Westg. 60 cy., 3 ph., 2300 v. Belted Bates Corliss Engine (13.3)

D. C. GENERATORS

1—300 Kw. Westg. Engine type 250 v., D.C., 240 R.P.M. (19.16)

D. C. GENERATOR SETS

1—75 Kw. C. W. 250 v., 2 w. Skinner engine (23.12)

MOTOR GENERATORS

1—25 Kw. G. E. Generator, 125 v., D.C. Motor, "IQ," 60 cy., 2 ph., 220 v., 1200 R.P.M. (23.12)

ROTARY CONVERTERS

1— 200 Kw. Westg. 60 cy., 6 ph., 2300 v., 550 v., D.C. (4.8)
2— 500 Kw. Westg. 60 cy., 6 ph., 2300 v, 600 v. D.C. (21.15)
*1—2200 Kw. G.E. 60 cy., 6 ph., 13200/6600 v., 590 v. D.C. (7.1)

SQUIRREL CAGE MOTORS

1—25 H.P. Lincoln, 60 cy., 3 ph., 440 v., 720 R.P.M. (14.23)
2—30 H.P. Westg. "C.S." 60 cy., 3 ph., 440 v., 3400 R.P.M. (14.23)
2—40 H.P. Westg. "CS" 60 cy., 3 ph., 440 v., 1200 R.P.M. (14.23)

SYNCHRONOUS MOTORS

1—150 H.P., G.E., "ATI," 60 cycle, 3 ph., 440 v., 720 R.P.M. (21.16)
2—200 Kva., G. E., "AQI," 60 cycle, 2 ph., 2,300 v., 900 R.P.M. (125)
2—1500 H.P., G.E. "ATI," 60 cycle, 3 ph., 2,300 v., 257 R.P.M. (3.11)

SLIP RING MOTORS

5—15 H.P. Westg. "CW" 60 cy., 3 ph., 220/440 v., 1800 R.P.M. (14.23)
1— 75 H.P. Allis. "ANY" 60 cy., 3 ph., 440 v., 1750 R.P.M. (14.28)
*1—100 H.P. G. E. "MTC" 25 cy., 3 ph., 440 v., 1750 R.P.M. (12.2)
4—125 H.P. Lincoln "C17" 60 cy., 3 ph., 440 v., 1750 R.P.M. (16.10)
1—150 H.P. Allis. "ANY" 60 cy., 3 ph., 440 v., 1750 R.P.M. (14.28)

CRANE MOTORS

6— 10 H.P. Westg. "C" 25 cy., 3 ph., 440 v., 750 R.P.M. (23.16)
16— 30 H.P. Westg. "C" 25 cy., 3 ph., 440 v., 750 R.P.M. (23.16)

TRANSFORMERS, 60 CYCLE

28— 5 Kva. Westg. "S" 1 ph. 6,900 v. —460/230 v. (23.14)
16— 10 Kva. Westg. "S" 1 ph. 6,900 v. —460/230 v. (23.14)
10— 10 Kva. Westg. "S" 1 ph. 2,300 v. —460/230 v. (23.14)
1— 30 Kva. Westg. "S" 1 ph. 2,200 v. —110/220 v. (21.16)
3—37½ Kva. Westg. "S" 1 ph. 2,200 v. —110/220 v. (21.16)
13— 50 Kva. Westg. "S" 1 ph. 6,900 v. —460/230 v. (23.14)
7— 75 Kva. Westg. "S" 1 ph. 2,300 v. —460/230 v. (23.14)
1— 100 Kva. G. E. "H.T.—R.P." 1 ph. 11,000/22,000 v.—2,200/4,400 v. (4.5)
7— 100 Kva. Westg. "S" 1 ph. 6,900 v. —460/230 v. (23.14)
3— 333 Kva. G. E. "H—R.P." 1 ph. 11,500/23,000—2,200/2,400 v (4.5)
1— 400 Kva. G. E. "H.T.—R.P." 1 ph. 10,000 v.—1,100 v. (4.5)
3— 500 Kva. G. E. "W.C.—B." 1 ph. 21,000 v.—2,300 v. (4.5)
1— 500 Kva. G. E. "W.C.—H.D." 1 ph. 19,000/21,000 v.—2,100/2,300 v. (4.5)
3— 500 Kva. G. E. "O.I.—W.C." 1 ph. 44,000 v.—2,200 v. (14.26)
1—1000 Kva. G. E. "O.I.S.C." 3 ph. 66,000 v.—13,200/22,850 (14.26)
1—1550 Kva. G. E. "O.I.W.C." 1 ph. 44,000 v.—2,200 v. (14.26)
* 3—2000 Kva. Westg. "O.I.S.C." 1 ph. 66,000 v.—25,000 v. (23.13)
4—3333 Kva. Westg. "W.C." 1 ph. 11,800 v.—2,380/4,125 v. (8.8)
* 2—8,500 Kva. G. E. "W.C." 3 ph. 24,000 v.—2,400 v. (21.14)

TURBO GENERATORS

1— 400 Kw. Westg. 60 cy., 3 ph., 240 v. 6,000/900 R.P.M. 100 No. 8 (9.1)
1— 500 Kw. Westg. 60 cy., 3 ph., 2,400 v. 3,600 R.P.M. 175 No. 8, 100 deg. S.H. (13.2)
1— 750 Kw. Westg. 60 cy., 2 or 3 ph., 2,300 v., 3,600 R.P.M., 160 No. 8 (2.12)
1—1000 Kw. G. E. 60 cy., 3 ph., 2,300 v. 3,600 R.P.M. 175 No. 8 (11.86)
1—1500 Kw. G. E. 60 cy., 3 ph., 2,300 v. 3,600 R.P.M. 175 No. 8 (11.86)
1—3500 Kw. Westg. 60 cy., 3 ph., 2,300 v. 1,200 R.P.M. (2.13)

* Never used. † Reference number.

Have You Any Surplus Electrical Equipment?

ALLEN ASHLEY
150 W. 42D STREET, NEW YORK
Telephones: BRYANT 4325-2129
"Surplus Machinery Clearing House"

TRANSFORMERS

All Transformers Have Necessary Oil

5—6-10-kva. G. E., 440-110 v.
1—1-kva. G. E. Transformer, 1040-2080 v. primary, 115-230 v. secondary.
2—5-kva. Westinghouse Transformers, 2200 v. primary, 230-115 v. secondary.
1—5-kva. Gen. Elec. Transformer, 1100-2200 v. primary, 110-220 v. secondary.
10—75-kva. Wagner, 220 v. primary, 460-230 v. secondary.
3—50-kva. Pittsburgh Transformers, 5700-6600 v. primary, 110-220-440 v. secy.
1—75-kva. Westinghouse, 2200 v. primary, 440-220 secondary.
1—75-kva. Westinghouse, 2400 v. primary, 480-240 v. secondary.
3—100-kva. Packard, 2300 v. primary, 440 v. secondary.
16—100-kva. Wagner, 2200 v. primary, 460-230 v. secondary.
3—100-kva. G. E., 2300 v. primary, 230-460 v. secondary.
4—200-kva. Wagner Transformers, 6600 v. primary, 220 v. secondary.
7—100-kva. Packard, 33,000 v. primary, 2300 v. secondary.
2—400-kva. G. E., 33,000 v. primary, 2300 v. secondary.
3—500-kva. G. E., 29,700-33,000 v. primary, 2300-4000 v. secondary.

Miami Conservancy Dist.
Electrical Division—Dayton, Ohio.

Steel Poles

1600 Hollow, Round, Steel Poles, approximately 10 ft. 3 in. high, weight 52 lb. each.

Suitable for Lamp Posts, Cable Carriers, or heavy Fence Posts.

Big Bargain

NATHAN KLEIN & CO.
MOTORS CENTRE & HOWARD STS., N.Y. DYNAMOS

UNITS—A.C., 3-PH., 60-CY.
1500-kw. Allis 2300 Allis Steam Turb.
937-kw. Allis, 480 Allis Steam Turbine.
500-kw. G. E., 480 32x48 F. & S. Corliss.
475-kw. G. E., 2300-v. Skinner Uniflow.
3—300-kw. Westghse., 2300 18x28x24 Ham. Cor.
250-kw. Allis, 2300 Kerr Steam Turbine.
3—185-kw. W. E. 440 18x17 4-v. Harr'g.
3—125-kw. G. E., 440 18x17 Herrisb'g, 4-valve.
2—85-kw. Ft. W. 2300 12x18 Erie, 4-valve.

UNITS—D.C., 250 VOLTS
400-kw. G. E. 24x42 Ham. Cor.
350-kw. Westghse., 25x30 Skinner Uniflow.
300-kw. Westghse. Harrisburg, 4-valve.
250-kw. C. W., 20x24 Chuse, 4-valve.
2—200-kw. Westghse. 3 wire, 18x36 Corliss.
200-kw. F. W., 20x42 Bass Corliss.
150-kw. Westghse. 18x16 Erie Ball.
100-kw. G. E. Ideal Simple.

ENGINES 13x13 and 18x18
BOILERS 2—600 hp.BW.4—315 hp. Ster.

Motors—Air Compressors—Generators
Let Us Know Your Needs
H. R. Wilson Machinery Co., 417 Pine St., St. Louis

CONDENSERS

2—No. 30 Schutte and Koerting Multi Jet Condensers.
1—No. 5 Allis-Chalmers vertical jet condenser.
1—Ross surface condenser, size 200.
Write for list of Power House equipment.
NASHVILLE INDUSTRIAL CORPORATION
Old Hickory, Tennessee

Blowers and Fans

1—160-in. Buffalo Steel Plate Induced Draft Fan.
2—120-in. Buffalo Steel Plate Induced Draft Fans.
10—Connersville 26x36-in. horizontal top discharge gas blowers.
8—24-in. Buffalo electric disc fans, single phase motors.
8—30-in. Buffalo electric disc fans, single phase motors.
2—No. 3 Root High Pressure Style D Blower.

Write for prices and specifications.

NASHVILLE INDUSTRIAL CORP.
Old Hickory, Tennessee

1000 G.P.M., 100 LB.—480 V., 60 CY., 3 PH. CENT. UNDERWRITERS PUMP
1000 KW., 480 V., 60 CY., 3 PH. TURBO.
750 KW., 600 V., 60 CY., 3 PH. TURBO.
187 kva., 240/480-v., 60-cy., 3-ph. Engine Sets. Exceptional Bargains.

60 Cycle, 3 Phase Turbos
2500-1250-937-500 kva. Turbos.
1000-750-500-400-300 hp. Motors.
25-60 cy. Rotaries and Freq. Changers.

4000 EDISON STORAGE BATTERIES
10 Batteries per Case. 3 Cell 18 amp. Type BB-4. In original packages.

ROSS POWER EQUIP. CO.
Indianapolis, Ind.

TRANSFORMERS

New and Nearly New

O. I. S. C. outdoor type, single phase, 60 cy., 6,600 to 6,900 or 11,400 to 11,900 v., "Y" to 220/440 secondary.
12—100 kw.@$300.
3—150 kw.@$375.
6—200 kw.@$425.
5—300 kw.@$550.
2—50 kw. with 120/240 Sec.@$250.

ROY BRENHOLTS, Trustee
44 East Broad Street, Columbus, Ohio

Automatic Spot Welder

47 kw. Winfield Automatic Spot Welder, $500.

Motors

25—¼ hp., 1 R.K.T., 3 ph., 6 cy., 220 v., 1800 r.p.m. motors, $10 each.

Motor Generator

45 kw., 125 v., D.C., Westinghouse, S. K. Generator, to 75 hp. G.E. slip-ring motor, 2 or 3 ph., 60 cy., 220 v., $1000.

L. J. LAND
207 Centre St., New York City.

Power Plant Equipment

1—1500 and 1—750 kw. G. E. Turbines, 3 ph., 60 cy., 2300 v.
3—Wheeler Condenser Equipments.
4—500 hp. Stirling W.T. Boilers.
Boiler Feed Pumps, Feed Water Heaters, Air Compressor, Exciter Sets, Piping, etc.

New Pittsburgh Coal Company
R. W. Mackensen, Secy.-Pur. Agt.
Columbus, O.

FOR SALE

New 627 H. P. Boiler

1—New 627-hp. Springfield All-Steel Sectional Water Tube Boiler, working pressure 225 lbs., heating surface 6271 sq. ft. Anyone contemplating installing a new boiler can get this one for immediate delivery. Write for complete specifications and price f.o.b. cars Springfield.

U. S. Food Products Corp. (Ill.)
Surplus Property Branch
Peoria, Illinois.

Air Compressors For Sale

1—Laidlow Dunn Gordon Air Compressor; steam size 5 in. (Corliss Type Poppet Valve) 15½ in. diameter high pressure cylinder, 25 in. diameter low pressure cylinder, 36-in. stroke. Air cylinder 16 in. high pressure, 26 in. low pressure, 6-in. air line; capacity 2200 cu. ft. at 110 lbs.
1—Chicago Pneumatic Tool Company Air Compressor (Slide Valve) Steam Pipe 5 in.; 20 in. high pressure, 31 in. low pressure, 24-in. stroke. Air 16½ in. high pressure, 27 in. low pressure; 6-in. air line; 1580 cu. ft. of air per minute of 100 lbs.

Call or Write.

J. F. TORRENCE
3722 Fifth Avenue, Pittsburgh, Pa.

FOR SALE

Street Lighting Regulator

62 kw. General Electric Type R. N., Form C. L., 60 cy. Primary voltage 2200; secondary amp. 6.6. Serial No. 498516.

W. N. ALBERTSON & CO., INC.
First Wisconsin Nat'l Bank Bldg.,
Milwaukee, Wisconsin.

TURBO-ALTERNATOR For Sale

Account contracting for central station energy in Jersey City, N. J. 250-kva., 200-kw., 600-2300-v., 3-ph., 60-cy., 3600 r.p.m. Allis-Chalmers alternator, direct connected to Kerr multistage turbine, condensing or non-condensing; complete switchboard. New 1919; splendid condition. Can be seen operating.

SWIFT & COMPANY
Construction Dept., Chicago, Ill.

STEEL PILING

All Lengths and Makes
We sell large quantities for construction power plants, hydro-electric projects, etc.

ZELNICKER IN ST. LOUIS
Phone—Olive 3910
Rails, Railway & Contractors' Equipment, etc.

INSULATORS

75—High tension, 5 unit, pillar type, G.E. and Westinghouse. New. At one-third original cost.
Also large assortment of new Lightning Arresters.

HACKLEY MORRISON CO.,
Incorporated
1708 Lewis St., Richmond, Va.

Westinghouse Direct Current Motors

Type S-SA - SK - CD - 50% off list.
Write for our complete list.
IVES MFG. COMPANY
Baltimore, Md.

BOILERS AT LOW COST

12—823 hp. Babcock & Wilcox Stirling Water Tube Boilers, Class M-30. 200 lbs. pressure. Westinghouse stokers and all accessories.
2—300 hp. Heine boilers, 150 lbs. pressure. Murphy stokers and accessories.
Write for list of Power House Equipment.
NASHVILLE INDUSTRIAL CORPORATION
Old Hickory, Tennessee

"Opportunity" Advertising:

Think
"SEARCHLIGHT"
First!

0099

USED POWER EQUIPMENT

Released from service by a number of public utility companies

Electrical—Hydraulic—Mechanical

Our summary contains a complete list of equipment under above classification

WRITE TODAY FOR YOUR COPY A

Phoenix Utility Co., 71 Broadway, New York City

FOR SALE

1—Westinghouse-Parsons Steam Turbine, Serial No. 192, 1200 r.p.m., straight reactance, single flow, balance wheel type, direct connected to:

1—Westinghouse A.C. Generator 2000 K.W. 2350 KVA., 11000 Volts, 105 ampere per teminal, three phase, 60 cycle, 1200 r.p.m. Serial No. 413303.

Call or Write

J. F. TORRENCE

3722 Fifth Avenue, Pittsburgh, Pa.

OIL ENGINES

Full and Semi-Diesel

of best known makes and types. New and rebuilt, for both stationary and marine service.

20 BHP. to 3000 BHP.

Gas and Gasoline Engines

for all power purposes.

Write or wire full details of your requirements for quotations, proposals and deliveries.

A. McMILLAN

Specialist in Diesel type oil and other Internal Combustion Engineering.

628 Monadnock Block, Chicago, Ill.

MOTORS

All motors are interchangeable, 440 or 220 v., 60 cy., 3 ph., A.C., 40 deg., unless otherwise stated, and are complete with starters.

3—7½-hp. Gen. Elec. motors, cage type, 900 r.p.m.

1—25-hp. Imperial Motor, 1800 r.p.m., Frame 241, Class A, Form C.

2—500-hp. (Type "Any" 14-36-11) Allis-Chal. Fully Enclosed slip-ring, resistance grids and control panels.

2—350-hp. (Type "Any" 14-36-12½) Allis-Chal. Open Type slip-ring, resistance grids and control panels.

Motor Repair Parts and Electrical Supplies. Send for Catalog.

Miami Conservancy Dist.

Electrical Division—Dayton, Ohio.

CRANES

2—6-ton Hand operated 36-ft. span, with runways and supporting columns. Practically new. $800.00 each.

Power Machinery Exchange, Inc.

1 Montgomery St., Jersey City, N. J.

Real Bargains

BOILERS

4—525 hp. B. & W., 165 lbs., Rohney Stokers.

2—440 hp. B. & W., 200 lbs. Murphy Stokers. Diamond Soot Blowers.

3—330 hp. Heine, ASME, 180 lb., Detroit Stokers.

1—350 hp. Stirling, 175 lbs. hand fired.

2—207 hp. Geary, 170 lbs. hand fired.

2—175 hp. Atlas. 150 lbs. hand fired.

6—150 hp. 72x18 H. R. T., Ohio Std., 125 lb.

ROTARY CONVERTERS

1—300 kw., G. E., type HCC, 275 v. D.C., 6 phase, 60 cycle, 2300/4000 v. A.C.

1—150 kw., G. E., type HCC. 275 v. D.C. 3 phase, 60 cycle, 2300/4000 v. A. C.

A. C. GENERATORS

3 phase, 60 cycle.

1—625 kva., Allis-Chalmers, 220 volts. 120 r.p.m. D.C. 24x42 Corliss Engine.

1—625 kva., Westinghouse, 2300 volts, 150 r.p.m. D.C. 18x38x30 Hamilton Corliss Engine.

1—500 kw., G.E., 480 volts, 3600 r.p.m. condensing Horizontal Turbine.

1—400 kw., G. E. 220 v., 1800 r.p.m., non-condensing Horizontal Turbine.

1—315 kva., Ridgway 240 volts, 180 r.p.m D.C. to 22x24 Ridgway Engines.

1—175 kva., Burke, 480 volts, 257 r.p.m., D.C. to 10x16 Erie-Ball Automatic Engine.

1—62½ kw., Lincoln, 480 volts, D.C. 11x12 Chandler & Taylor Automatic Engine.

D. C. GENERATORS

1—150 kw., Allis-Chalmers, 125 volts, D.C. 18x18 Skinner Engine. (Also for 250 v.)

2—100 kw., Western Elec., 125 volts, D.C. 15x15 Skinner Engines. (also for 250 v.)

1—75 kw., G. E., 250 volts, D.C. 14x14 Ideal Engine.

1—50 kw., Triumph, 125 volts, D.C. 11x12 Skinner.

1—50 kw., Crocker-Wheeler, 125 volt, 275 r.p.m. 400 Amper. Generator D.C. to 12x12 Brownell, Enclosed type Automatic Engine.

1—17½ kw., Triumph, 125 volts, D.C. 8x8 Troy Engine.

The Randle Machinery Co.

1822 Powers Street, Cincinnati, Ohio

FOR SALE

2—175 kw. Westinghouse D.C. **Generators,** driven by Rathbun-Jones 3 cyl. 21x20 gas engines.

1—Rathbun-Jones 17x17, 3 cyl. **Gas Engine,** with belt pulley.

1—22.5 kw. Crocker-Wheeler D.C. **Generator.**

1—14 kw. Westinghouse D.C. **Generator.**

2—**Transformers,** Westinghouse, 240-120 v., Type S. No. 11735-4B.

60—**Electric Motors,** D.C. and A.C., up to 75 hp.

2200 ft. No. 0 Standard Lead Covered **Cable,** 19 strands.

300 ft. No. 00 Standard Lead Covered **Cable,** 19 strands.

350 ft. No. 3 Duplex Standard Rubber Covered **Cable.**

350 ft. No. 3 Duplex Standard Lead Covered **Cable,** 7 strands.

250 ft., 1,250,000 C.M. Lead Covered **Cable.**

300 ft. No. 00 Standard Rubber Covered **Cable,** 19 strands.

1000 lbs. No. 0 Solid Rubber Covered **Cable.**

150 ft. No. 0 Standard Rubber Covered **Cable,** 19 strands.

150 ft. No. 000 Standard Rubber Covered **Cable,** 19 strands.

150 ft. No. 0000 Standard Rubber Covered **Cable,** 19 strands.

Traylor Engineering & Manufacturing Company

Allentown, Pa.

FOR SALE

Diesel Oil Engine

McINTOSH & SEYMOUR

665 hp. direct connected to 500 kw., 25 cycle generator.

TRANSFORMERS

3—300 kva., 19100/33000 v—370 v.

Type H, Form VDD.

Olean, Bradford and Salamanca Railway Company

Olean, New York.

FREQUENCY CONVERTER

Westinghouse 3 Bearing

Generator: 2500 kva., 2300 volts, 463 amps., 2 or 3 phase, 750 r.p.m.

Motor: 2780 hp. (2140 kva. 1. P. F.) 3 phase, 25 cycle, 2300 or 6600 volts, 750 r.p.m.

Exciter: Direct connected, 165 kw., 115/230 volts, compound wound, 6 pole, interpole type, 750 r.p.m. Complete with:

Exciter field discharge resistance, Motor field discharge resistance, Field rheostats for exciter, motor and generator.

PRICE $7500

The exciter on this set is sufficiently large to use as a starting motor if desired.

Generator is a 2 phase machine at the present time but can be reconnected for 3 phase, 2300 volts or 3 phase, 6600 volts without loss in capacity.

Price includes set of new Westinghouse coils of any standard voltage for motor.

MOORE & MacDONALD

26 Cortlandt St., New York

ELECTRICAL EQUIPMENT

125—Motors ¼ to 150 hp.

22—Type H No. 211982 (W) oil circuit breakers.

Write for Bulletin 21 listing large stock of motors, generators, transformers, conduits, panels, switches, etc.

NASHVILLE INDUSTRIAL CORPORATION

Old Hickory, Tennessee

TURBINES—CONVERTERS

1—500-kw., 3600-r.p.m., G.E., 2300-v., 3-ph., 60-cy. turbine, Jet Cond., Ex., and all accessories

1—300-kw., G.E. Rotary with 6600 v. transformers,

1—200-kw. G.E., with 22000/11000 v. transform's.

3—200-kw. Westghse., with 6600 v. transformers. 11000/6600 v. transformers for 500 kw. Converter.

All transformers, single phase, 60 cycle, O.I.S.C. Railway Type Converters, 600 volts D.C.

C. M. ROSWELL

1162 Marlyn Rd., Philadelphia, Pa.

Accumulators and Compressors

2—42x11½x50 Hydro Pneumatic Accumulators.

4—15 and 20x20x24 Compound Duplex Laidlaw Compressors. Pressure 60 lbs.

Write for list of Power House Equipment

NASHVILLE INDUSTRIAL CORPORATION

Old Hickory, Tennessee

Founded 1878 — OKONITE — Incorporated 1884

TRADE MARK.

The Standard for Rubber Insulation

FOR 45 years the name "Okonite" has stood for the highest quality of Electrical Insulation for Wires and Cables.

"Okonite" itself is a rubber compound never containing less than 30% by weight [over 60% by volume] of high grade Para Rubber with absolutely no admixtures or substitutes.

All products bearing the Okonite trademark carry with them our unconditional guarantee of excellence and unvarying reliability.

Okonite is made in but one grade.

THE OKONITE CO., Passaic, N. J.

Sales Offices:
NEW YORK ATLANTA PITTSBURGH SAN FRANCISCO

Agents: Central Electric Co., Chicago, Ill. The F. D. Lawrence Electric Co., Cincinnati, O. Pettingell-Andrews Co., Boston, Mass. Novelty Electric Co., Philadelphia, Pa.

Canadian Representatives: Engineering Materials, Ltd., Montreal

MANSFIELD

The Proper Way to Remove Burrs

from punchings is to eliminate them before they start. Use good dies, regrind when burrs begin to appear. Then use MANSFIELD ELECTRICAL SHEETS and keep the regrinding to a minimum.

MANSFIELD ELECTRICAL SHEETS ARE CLEAN INSIDE and OUTSIDE—AND GIVE MAXIMUM RESULTS

MANSFIELD SHEET & TIN PLATE CO., MANSFIELD, O.

ELECTRICAL SHEETS

MOLDED INSULATION

BAKELITE-CONDENSITE-ROXITE

Machine Moulding of Small Parts a Specialty

Prompt Deliveries.

Send us your blueprints

NORTHERN INDUSTRIAL CHEMICAL COMPANY

11 Elkin Street, South Boston, Mass.

LAVAROCK Insulations

Highest Heat Resistance and Dielectric Strength

M. KIRCHBERGER & CO., Inc.

1427—37th St., Brooklyn, N. Y.

Newport Electrical Sheets

"BEST BY TEST"

Newport Armature. Newport Electrical "A".

Newport Electrical "A" Special.

Newport Pole Piece Steel. Newport Rotor Steel.

Write us for full information

NEWPORT ROLLING MILL CO.

Newport, Kentucky

BAKELITE

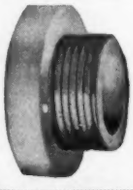
TRADE MARK REG. U. S. PAT. OFF.

Molding Materials; Laminated Sheets, Tubes and Rods; Insulating Varnishes and Cements.

BAKELITE CORPORATION

247 Park Avenue, New York, N. Y.

Chicago Office: 636 West 22nd Street



LAVITE

High Grade—Heat Resisting

Machined as Accurately as Brass

INSULATION

D. M. STEWARD MFG. CO.

Chattanooga, Tenn.

PORTSMOUTH ELECTRICAL

ELECTRICAL SHEETS

Unequaled for the Magnetic Circuit

The various grades are made throughout for the purpose desired. Good clean steel is alloyed with the proper amount of Ferro-Silicon to give the results desired. It is carefully followed and inspected in every process from the open hearth to the finished sheet. The result is a highly desirable sheet, clean, free from loose iron oxide scale, correctly annealed, non-aging, having low core losses, and good permeability.

Made under license from Sir Robert Hadfield's patents. We will appreciate an opportunity of quoting you or of sending a specialist to consult with you.

WHEELING STEEL CORPORATION

Electrical Sheet Dept., Wheeling, W. Va.

Ask for Kruesi's Book

LAVA

unchanging, durable and always uniform under widely fluctuating temperatures, its applications for insulating purposes are unlimited.

AMERICAN LAVA CORPORATION

1419 Williams St., Chattanooga, Tennessee

NATIONAL VULCANIZED FIBRE CO.

Wilmington, Del., U. S. A.

World's Largest Manufacturers of

HIGHEST RESISTANCE ELECTRICAL FIBRE

See our large advertisement in other issues

Uniform Gauge

of Enamel or Cotton Insulation.

Thorough Inspection
Each spool carries an individual inspection number.

Shipment from Stock
Quick delivery of American Magnet Wire is assured. Write for prices.

The American Enameled Magnet Wire Co.,
Muskegon, Mich.

"American Brand"

Weatherproof Wire and Cables,
Bare Copper Wire and Cables

has no equal for long, satisfactory economical service.

American Insulated Wire and Cable Co.
21st, Sangamon and Morgan Sts., Chicago

Americore

RUBBER COVERED WIRE
for INTERIOR WIRING

Highest Standard of Excellence
Send for descriptive book

American Steel & Wire Company
Chicago - New York

INTERIOR CONDUITS

American Circular Loom Co.

90 West Street
New York

Boston Los Angeles Seattle
Chicago San Francisco Toronto

Magnet Wire that gives Dependable Quality to Electrical Apparatus

Magnet Wire that gives Dependable Quality to Electrical Apparatus must possess, above all, the characteristics of perfect insulation and long life. Because of the rigid tests of all materials and steps in the process involved in its manufacture, and because that process is scientifically correct, Maring cotton covered and enamel magnet wire has won high repute among manufacturers of quality apparatus.

MARING WIRE COMPANY
Muskegon, Michigan

Standard Underground Cable Co.
Manufacturers of
Electric Wires and Cables of all kinds; also Cable Terminals, Junction Boxes, etc.
Boston New York Philadelphia San Francisco Pittsburgh
Washington Chicago Detroit St. Louis

SAMSON SPOT CORD
FOR HANGING ARC LAMPS

Trade Mark Reg. U. S. Patent Office

SOLID BRAIDED COTTON—WATER PROOFED
Send for Catalogue and Samples
SAMSON CORDAGE WORKS, BOSTON, MASS.

Note Protection at Corners

Blake Insulated Staples

Unequalled for telephone and bell wiring. The fibre insulation prevents troublesome short circuits and grounds. 4 sizes. Pat. Nov., 1900. Write for Samples.

Blake Signal & Mfg. Co.
Boston, Mass.

Hazard

RUBBER INSULATED

WIRES & CABLES

FOR over 25 years Hazard Wires and Cables have served the real needs of those who demand the greatest possible factor of safety in their electrical conductors.

The supreme importance of really efficient rubber insulation on Wires and Cables is too often overlooked.

Safety to life and limb, and long lasting service should carry more weight than low price or any other consideration.

HAZARD Wires and Cables are *safe*. They stand up under unexpected surges in current because a high factor of safety is built into them—the compound ingredients are right, the formula is right, and the supervision and testing service are thorough.

Hazard Mfg. Company
Wilkes-Barre, Pa.

NEW YORK 533 Canal St. | PITTSBURGH 1st Nat'l Bank Bldg.
CHICAGO 552 W. Adams St. | DENVER 1415 Wazee St.
PHILADELPHIA 1004 Race St. | BIRMINGHAM 1701 First Ave.
SAN FRANCISCO, Maydwell & Hartzell, Agents, 158 11th St.

THE WORLD'S STANDARD

"IRVINGTON"

Black and Yellow
Varnished Silk, Varnished Cambric, Varnished Paper

Irr-O-Slot Insulation Flexible Varnished Tubing
Insulating Varnishes and Compounds

Irvington Varnish & Insulator Co.
Irvington, N. J.
Sales Representatives in the Principal Cities

Porcelain Cement

High strength Mineral Cement for cementing brackets, screws and bolts to porcelain and glass insulators.
Write to us for information on your cementing problems.
REPARIT MANUFACTURING CO.
701 Railway Exchange Bldg., Milwaukee, Wis.

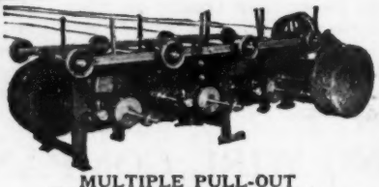
"GARFIELD" INSULATION

GUMMON

"GUMMON" is the standard and original Cold Molded Insulation, made by the oldest and largest producer. Continuously improved to meet increasingly exacting requirements.
GARFIELD MFG. CO.
Garfield, N. J.

EST. 1865 AIMco INC. 1915
"American" INSULATING MACHINERY COMPANY
REG. U.S. PAT. OFF.
PHILADELPHIA PENNSYLVANIA U.S.A.

MACHINES FOR
DRAWING
MEASURING
RESPOOLING
SATURATING
RECLAIMING
ENAMELING
INSULATING
PANNING
VULCANIZING
TAPING
TWINING
CABLING
STRANDING
OF WIRE



MULTIPLE PULL-OUT
With TRAVERSE for 8 Reels.
Has 8 Independently Operated
FRICTION CLUTCHES

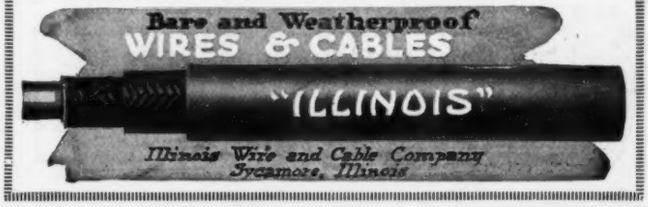
HARD PORCELAIN

For Electrical Specialties
IMPERIAL PORCELAIN WORKS
TRENTON, N. J

ELECTRICAL WIRES AND CABLES
JOHN A. ROEBLING'S SONS CO., Trenton, N. J.

DEPENDABLE SAFETY INSULATIONS

SAFETY INSULATED WIRE & CABLE CO.
114 Liberty Street, NEW YORK
CHICAGO BOSTON
SAN FRANCISCO



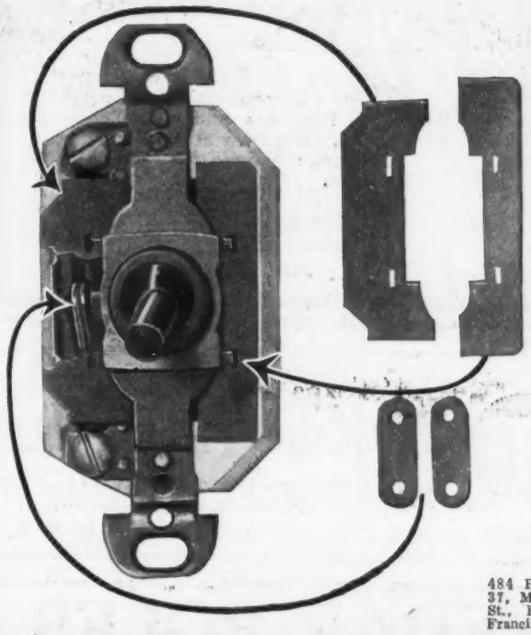
SILK

For Electrical Purposes
Silk for Insulating Finest Wire
ALL KINDS BRAIDING SILK

William Ryle & Co., 381 Fourth Ave., Cor. 27th St. New York City

Belden
A SYNONYM OF QUALITY
IN ELECTRICAL WIRE PRODUCTS
BELDEN MANUFACTURING COMPANY
WESTERN AVENUE AT TWENTY-THIRD STREET, CHICAGO

For electrical parts widely used in homes



You can't be too careful when selecting an insulator for electrical parts that are widely used in homes and public buildings and in daily use by everyone.

This is why Spaulding Hard Fibre is used by the manufacturers of wall switches, snap switches, sockets and attachment plugs, whose names are synonomous with highest quality.

Its great electrical resistance and mechanical strength are two of the reasons for its wide-spread popularity. *Write for Samples and Prices*

SPAULDING FIBRE CO., INC.,
312 Wheeler St.,
Tonawanda, N. Y.

Branch Offices and Warehouses:
484 Broome St., New York City; 15 Elkins St., Boston, 37, Mass.; 659-661 W. Lake St., Chicago; 141 N. 4th St., Phila.; Clapp & Lamoree: 171 Second St., San Francisco, Calif.; 310 East 4th St., Los Angeles, Calif.

Another Spaulding Insulating Material

—is Spaulding Bakelite-Duresto. It is a laminated phenolic condensation product that possesses high dielectric and mechanical strength—resists heat and cold—will not absorb water—is impervious to dilute acids, salt water and steam—is not soluble in most of the ordinary solvents and will not deteriorate with time or exposure.

It possesses the high insulating qualities required for switch panels, terminal blocks, parts for wireless instruments, working under stress of high frequency, radio apparatus, such as panels, coils, couplers and numerous other electrical uses.

Send for Samples and Prices.

Spaulding BAKELITE DURESTO

SPAULDING Fibre COMPANY

Spaulding Hard Fibre

This Company maintains a Special Department devoted exclusively to the production and improvement of

SHEETS

For Electrical Apparatus

OUR SILICON ALLOY SHEETS (Hadfield Patents) are of special value and interest to all builders of dynamos, motors, transformers, etc. Write us for full information on Apollo Special Electrical, Dynamo Special Electrical, Motor Special Electrical, U. S. Electrical, American Armature, Pole Steel and Rotor Steel Sheets. Shall we send electrical sheet booklet?

AMERICAN SHEET & TIN PLATE CO. APOLLO SPECIAL ELECTRICAL TRADE MARK REGISTERED PITTSBURGH

We also manufacture Sheet and Tin Mill Products for all purposes—Black Sheets, Galvanized Sheets, Special Sheets for stamping, Corrugated Sheets, Formed Roofing and Siding Products, Tin Plates, Terne Plates, Black Plate, Etc.

AMERICAN SHEET AND TIN PLATE COMPANY, Frick Bldg., Pittsburgh, Pa.

PLATINUM

BAKER MANGANIN

PROPERTIES

Melting Point, 910°C.
Specific Gravity, 8.4
Brinell Hardness:— Hard worked, 179
Annealed, 128
Resistance at 15° C. is approximately 300 ohms per mil. ft.
Temperature Coefficient of resistance between 15° and 30° C. is less than .00001 per °C.
Electromotive Force against Copper is 1.4 microvolts per °C.

Literature and quotations on request.

BAKER & CO., INC.
NEWARK, N. J.

PLATINUM

INSULATING COMPOUND
(TRUE TO NAME)
Insulating Waxes Saturating and Finishing
WAXES
For Rubber-covered and Weatherproof Wire. Insulating materials of all kinds. Combination Waxes.
HIGHEST EFFICIENCY GUARANTEED
Manufactured by
CANDY & COMPANY, Inc., CHICAGO

MICA

For Electrical and Mechanical Uses

Any Pattern, Size or Quality

INDIA—AMBER DOMESTIC

The largest and most complete stock in the country. Uncut sheet mica carefully selected to cut specified size making a minimum amount of waste. Sixty-nine years in the business is our record.

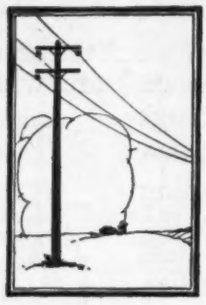
Samples and prices on application

EUGENE MUNSELL & CO.
New York: 68 Church St. Chicago: 542 S. Dearborn St.

ANACONDA
COPPER WIRE

ANACONDA COPPER MINING COMPANY
Conway Building, Chicago, Ill.

THE AMERICAN BRASS COMPANY
General Offices: Waterbury, Conn.



NAUGLE POLES

WESTERN & NORTHERN CEDAR

Butt-treated or plain

Since 1882. Reliable service—unquestioned quality. Large stocks — advantageously located concentrating yards. PENTREX butt-treatment.

NAUGLE POLE & TIE CO.
59 East Madison Street
CHICAGO

Install the "Franklin" and forget it!

"FRANKLIN"

Bus Bar Supports, Disconnecting Switches, Potheads and other specialties for power station work give the most value for the money invested.

Electrical Development & Machine Company
PHILADELPHIA

"Texas Black Beauty"

2T4 **CREOSOTED PINE**

Poles—Ties—Conduits

Pressure Treated—Will Last For Generations

Texas Creosoting Company, Orange, Texas, U. S. A.

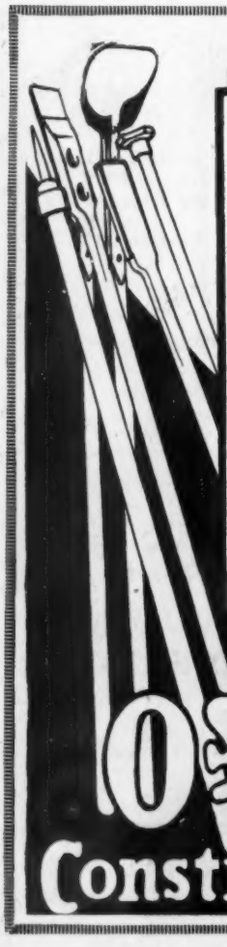
CEDAR POLES

Quick Delivery

Prices and Quality Satisfactory. "Producer Direct to Consumer"

J. J. SEGUIN

579 St. John Street, Quebec City, P. Q., Can.



Carrying Hooks
Cant Hooks
Wooden Mules
Digging Bars
Tamping Bars
Tree Trimmers
Pike Poles
Climbers
Deadmen

Spoons — Peavies
Loys — Shovels
Reels — Jenneys

Leach Company
629 Wood St., Oshkosh, Wis.
Formerly Oshkosh Mfg. Company

EW 6-28 M-RTG

OSHKOSH
Construction Tools

NORTHERN POLE & LUMBER CO.

Duluth, Minn.

Northern and Western

CEDAR POLES

Quick Shipments from Our Minneapolis Yard

BELL

NORTHERN — **CEDAR POLES** — WESTERN

BUTT TREATING — ANY KIND REQUIRED

BELL LUMBER CO., *Minneapolis, Minn.*

POLES

Western Red Cedar

Butt Treated or Untreated

Quality and service Guaranteed
W.R.C. Ass'n. Specifications or Class Poles
Producers and Shippers

"Shipments from Minnesota Transfer and Idaho points"

M. L. Bruce Company
150 Nassau Street, New York
Home Office, Sandpoint, Idaho

CEDAR POLES

Northern White Cedar
Western Red Cedar
Plain or treated Butts

Prompt shipments guaranteed. Ask for delivered prices

T. M. PARTRIDGE LUMBER CO.
Pole Department, Lumber Exchange, Minneapolis, Minn.

SPECIFICATIONS

Frame and Pins hot galvanized Association malleable iron.

Contacts bus bar copper reinforced with Springs.

Cartridge Castings brass with milled contact surfaces.

SPECIFICATIONS—Cont'd.

Cartridge Tube weatherproof outside best horn fibre inside.

Insulators best grade wet process porcelain tested to stand wet flash over of 45000 volts and cemented to pins under water. All parts interchangeable.

The Open Type Matthews Fuswitch

Rating 15,000 Volts, 100 Amperes, Rupturing Capacity Unlimited
Prices $11.00 Each, Less Than 25—25 or More, $10.00 Each.
Send for Bulletin 500 for full details.

W. N. MATTHEWS CORPORATION

MANUFACTURERS OF MATTHEWS MONEY SAVERS

ST. LOUIS, U. S. A.

BETTER DESIGN *BETTER RESULTS* *BETTER SERVICE*

Switches—Arresters—Fuses—Sub-Station Equipment

HI-VOLTAGE Equipment Company

Cleveland

OFFICE AND FACTORY 3305 CROTON AVENUE

Transmission Line and Special Crossing Structures, Catenary Bridges

WRITE FOR OUR NEW DESCRIPTIVE CATALOG.

ARCHBOLD-BRADY CO.

Engineers and Contractors SYRACUSE, N. Y.

Pole Top Switches
Disconnecting Switches
Switching Equipment for Manual and Motor Operation
Outdoor Substations
Bus Supports, Choke Coils for Indoor and Outdoor Service
Switchboard Fittings
Copper Fittings
Control Switches

for the good of the Service

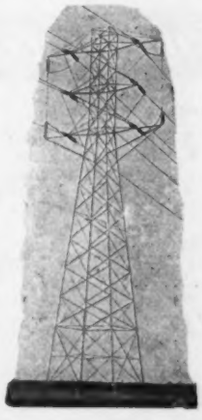
ELPEC

ELECTRIC POWER EQUIPMENT CORP.
412-20 N. 18th St., Philadlephia, Pa.

Milliken
Radio and Transmission Towers
Milliken Brothers Mfg. Co., Inc.,
Woolworth Bldg. New York

Steel Transmission Towers

RITER-CONLEY COMPANY
Pittsburgh

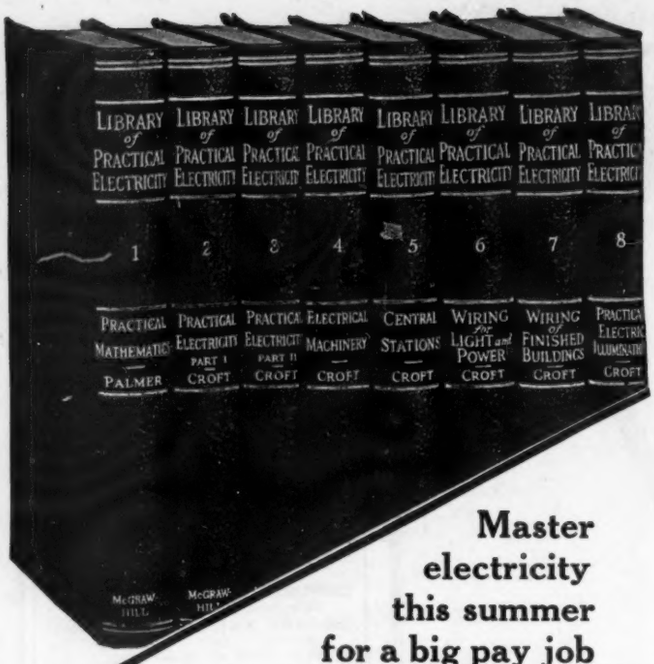


TRANSMISSION STRUCTURES
of
Special High Elastic Limit Steel

PACIFIC COAST STEEL COMPANY

Manufacturers of
OPEN HEARTH STEEL, Structural Shapes, Merchant and Reinforcing Bars.

General Offices:
Rialto Bldg., San Francisco
Plants:
San Francisco, Portland, Seattle



Master electricity this summer for a big pay job in the fall

You have a great chance this summer to put yourself in line for one of the really big paying electrical jobs. That trained men are needed is an old story, but it was never so true as it is now, as it will be next fall. There is an actual, urgent demand for men who know electrical practice complete, inside and outside work, central stations, and the whole subject.

Just a few of the cooler evening hours each week with the Croft books and by September you will have an electrical knowledge that will pay you well indeed. The Croft books tell you all that an expert must know. They are easily read. You can master them quickly and without trouble. They assure you of a bigger and better job.

It's worth doing—it's really worth doing—this summer.

The Croft Library

No course, no set of books offers a quicker, surer method of mastering electricity than the Croft Library. It is a complete electrical educator. It is founded on practice—on work as it is actually done. It is jammed from cover to cover with the kind of hard-headed facts you want. Written so that the beginner can easily understand it, yet so sound, so thorough, that it is the daily guide of thousands of highly paid electrical workers and engineers.

Croft and success go hand in hand. If your electrical training is obtained from these great books you are certain to win your way to the top.

Free examination—no money down—only $1.50 in ten days and $2.00 a month until paid.

Fill in and mail the coupon attached and we will send you the entire set of eight volumes for ten days' Free Examination. We take all the risk—pay all charges. You assume no obligation—you pay nothing unless you decide to keep the books. Then $1.50 in ten days and the balance at the rate of $2.00 a month. Send the coupon NOW and see the books for yourself.

Free Examination Coupon

McGraw-Hill Book Co., Inc., 370 Seventh Avenue, New York.

Gentlemen:—Please send me the Croft Library of Practical Electricity (shipping charges prepaid) for 10 days' free examination. If satisfactory, I will send $1.50 in ten days and $2.00 a month until the special price of $19.50 has been paid. If not wanted I will write you for return shipping instructions. (Write plainly and fill in all lines.)

Name .....

Home Address .....

City and State .....

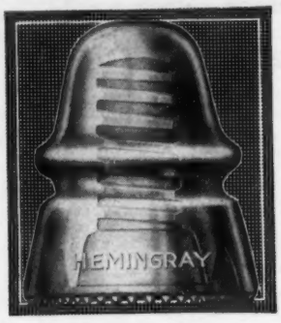
Employed by .....

Occupation ..... W. 6-28-24

HEMINGRAY

made in sizes up to 15,000 *volts*

EST. 1848



INC. 1870

For medium voltage lines

Insulate with Glass

Advantages!

(1) Transparency
Exposes internal defects

(2) Non-Porosity
Eliminates Moisture Absorption
Sustains dielectric strength
Prevents deterioration

(3) Homogenity
Insures uniform insulating properties throughout each insulator.

Up to 15,000 standardize on Glass

HEMINGRAY GLASS CO.

General Office and Factory Muncie, Ind.

G.P.Co

PORCELAIN INSULATORS

HIGH TENSION PIN-TYPE INSULATORS
WET PROCESS STRAIN INSULATORS

GENERAL PORCELAIN Co.

Parkersburg, West Va.

Shaw Lightning Arresters

Standard in the Electrical Industries for 35 years

Henry M. Shaw

150 Coit St., Irvington, Newark, N. J.

RAILWAY AND INDUSTRIAL ENGINEERING COMPANY

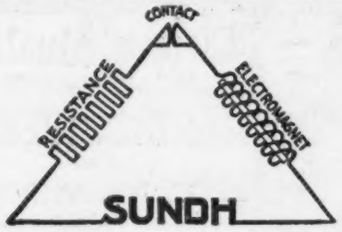
GREENSBURG, PA.

TRANSMISSION SWITCHING AND PROTECTIVE EQUIPMENT

DISTRICT OFFICES: PITTSBURGH NEW YORK BOSTON CHICAGO CINCINNATI

RAILWAY AND INDUSTRIAL ENGINEERING CO.

THE ELEMENTS OF OUR BUSINESS



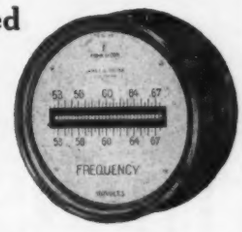
Automatic Starters	Pressure Regulators
Circuit Breakers	Remote Switches
Float Switches	Speed Regulators
Hand Starters	Transfer Switches
Magnet Switches	Valve Control

WRITE FOR CATALOG

Sundh Electric Company, Newark, N. J.

FRAHM Vibrating-Reed FREQUENCY METERS

are unaffected by temperature changes and can be relied upon to hold their calibration indefinitely.



The familiar "row of reeds" is seen on switchboards everywhere, and the Portable Type instruments are largely used by power companies as frequency standards.

There are no delicate springs or moving parts,—practically nothing to get out of order. Acquaint yourself with these instruments through Bulletin 995-W.

JAMES G. BIDDLE
1211-13 Arch Street, Philadelphia

THE

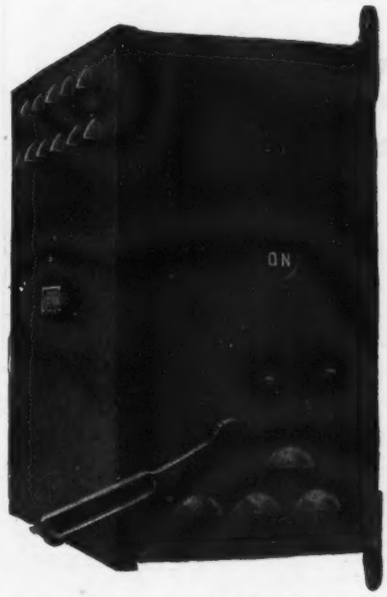
U-RE-LITE

is so much better than a fused switch that it is in a class by itself

Handbook just off the press send for it

THE CUTTER CO.
Philadelphia

How many breakers did you pay for last year and *not get*?



Roller-Smith type P "Safety" circuit breakers are unique. They are equipped with a strong, rugged, simple non-closable-on-overload mechanism. With this device, it is absolutely impossible to close the breaker or hold it closed while an overload exists.

Your fuse bill divided by the cost of a Roller-Smith Type P "Safety" circuit breaker gives a *minimum* figure. But this does not include three ever present losses as follows: 1. Cost of time due to shut downs. 2. Cost of lost production. 3. Cost of repairs necessitated by overfusing. It is a fact that if you are not now using circuit breakers ***you are paying for them just the same.***

For simplicity, ruggedness, speed, accuracy and reliability Roller-Smith circuit breakers are unexcelled. Open or enclosed, there is a type of Roller-Smith circuit breaker for every need. Bulletin No. D-560 gives all the details. Clip the slip.

Guarantee

The Roller-Smith Company guarantees ***all*** its apparatus to be made of materials carefully selected as best suited to the respective requirements and flawless so far as inspection and test preliminary to shipment can determine. It will replace or repair, within one year from date of sale, any defective apparatus provided it is returned f.o.b. the company's Works at Bethlehem, Pennsylvania, for that purpose.

ROLLER-SMITH COMPANY
Electrical Instruments, Meters and Circuit Breakers

MAIN OFFICE
237 Broadway, NEW YORK

WORKS
Bethlehem, Penna.

Offices in Principal Cities in U. S. A. and Canada

For your convenience
CLIP THIS SLIP
Request for Bulletin D-560
Name.....
Company.....
Address.....
City.....
State.....

Sherman Soldering Lugs

U. S. Patent Reissue 14401

Approved

WE have created a standard line of soldering lugs, making it unnecessary for people to use any old kind of lugs that they can get, or make their own.

A standard line that is absolutely efficient and rightly priced.

Sherman Soldering Lugs are marked with the N. E. C. rating in amperes across the flat portion at the wire end. This guarantees "approved" lugs.

Full particulars will be furnished on request.

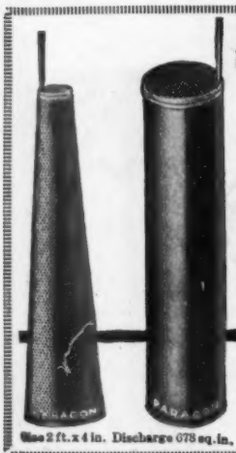
H. B. Sherman Mfg. Company
Battle Creek, Michigan

Thomas Quality
PORCELAIN INSULATORS
TRANSMISSION LINE HARDWARE
STANDARD WIRING PORCELAINS
and
ELECTRICAL PORCELAIN SPECIALTIES
"An American Standard since 1873"
The R. THOMAS & SONS Co. EAST LIVERPOOL, OHIO.
NEW YORK BOSTON CHICAGO LONDON
IN CANADA NORTHERN ELECTRIC CO.
ON PACIFIC COAST WESTERN ELECTRIC CO. INC.

Pittsburgh Transformer Company

Largest Manufacturers of Transformers exclusively in the United States

Pittsburgh, Pennsylvania



Paragon Grounds

Low Resistance. High Conductivity. Ample Capacity.

A plain, common-sense, inexpensive device accurately designed, carefully constructed of pure continuous copper throughout with no soldered or mechanical joints under ground.

Furnish adequate, dependable, durable grounding. Protect dependably valuable electric equipment from lightning, high tension crossed and other excess potential.

Complete directions for accurately and conveniently installing to insure efficiency of operation accompany every shipment.

PARAGON ELECTRIC CO.
Dearborn and Van Buren Streets
CHICAGO

Size 2 ft. x 4 in. Discharge 678 sq. in.

CRANES

Full Revolving
No Outriggers
Motor Truck Mounting

Send for Bulletin No. 22

The Universal Crane Co., 1169 Swetland Bldg. Cleveland, O.

AMERICAN BRIDGE COMPANY

EMPIRE BUILDING, 71 BROADWAY, NEW YORK

Manufacturers of Steel Structures of all classes, particularly

BRIDGES AND BUILDINGS

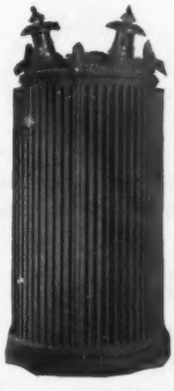
Sales Offices:

NEW YORK, N. Y.....71 Broadway
Philadelphia, Pa.....Widener Building
Boston, Mass.....120 Franklin Street
Baltimore, Md.....Continental Building
PITTSBURGH, PA.....Frick Building
Buffalo, N. Y.....Marine National Bank
Cincinnati, Ohio.....Union Trust Building
Atlanta, Ga.....Candler Building
Cleveland, Ohio.....Guardian Building
Detroit, Mich.....Beecher Ave. & M. C. R.R.
CHICAGO, ILL.....208 South La Salle Street
St. Louis, Mo.....Liberty Central Trust Bldg.
Denver, Colo.....First National Bank Bldg.
Salt Lake City, Utah, Walker Bank Building
Duluth, Minn.....Wolvin Building
Minneapolis, Minn.....7th Ave. & 2d St., S.E.

Pacific Coast Representative:
U. S. Steel Products Co., Pacific Coast Dept.

San Francisco, Cal.....Rialto Building
Portland, Ore.....Selling Building
Seattle, Wash.....4th Ave. So.; Cor. Conn. St.

Export Representative: United States Steel Products Co., 30 Church St., N. Y.



Kuhlman Transformers

A Type for Every Service

Specialists in transformer design and construction since 1893. Your order has the direct personal attention of interested executives.

Kuhlman Electric Co.
Bay City, Mich.

POTHEADS—DISTRIBUTION BOXES
Series Cut-Outs—Ground Caps
Send for Catalog
G&W Electric Specialty Co., 7440 S. Chicago Ave., Chicago

PORCELAIN INSULATORS
for in the station and on the line
TIME IS THE TEST
The OHIO BRASS Co., Mansfield, Ohio

Normal Position — Warning Position

The CONDIT Semaphore With Double Indication

Danger Position

FOR efficient transformer loading you can readily appreciate the advantages of the Condit "Standard" Double Indication Semaphore. A glance tells you whether a transformer is underloaded, efficiently loaded or about to become overloaded. Guesswork is entirely eliminated.

It's a safe, practical check on transformer operation.

Write for Bulletin—"Load by Temperature."

CONDIT ELECTRICAL MFG. CO.
Manufacturers of Electrical Protective Devices
South Boston, Mass.

6786

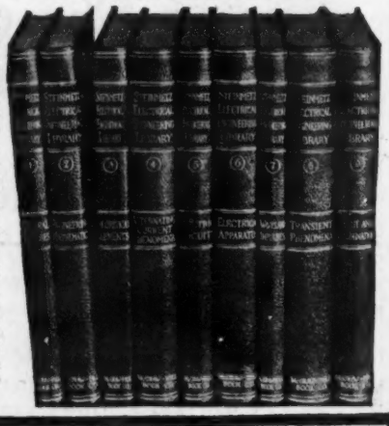
Put STEINMETZ in *Your* Library—

THE nine volumes which Dr. Steinmetz has contributed on the subject of electrical engineering are now available in a handsome specially bound set. To those who know what these great books have meant in the development of electrical engineering theory and practice—this announcement needs no elaboration. The Steinmetz books have been called the foundation of electrical practice. Their recognition is world-wide. In Europe, Japan, South America—in every corner of the globe—they are accepted standards and guides.

Have this handsome set with its full treatment of the theory and special problems of electrical engineering at your command. The handbook and the practical treatise may give you the simple fact you need—but Steinmetz gives you the theory and its application—the real solution of the problem.

See these books for 10 days FREE

You can examine the STEINMETZ ELECTRICAL ENGINEERING LIBRARY for ten days free. Simply fill in and mail the coupon below. This will not obligate you to purchase. You merely agree to return the books, postpaid, in ten days, or to remit $4.00 in ten days and $4.00 per month for eight months. Take this opportunity to see for yourself what these books are and how useful they could be to you. Remember that they are the latest revisions of the Steinmetz books in a handsome specially bound library edition at a price a little less than the regular editions of the books.



McGRAW-HILL

FREE EXAMINATION COUPON

McGraw-Hill Book Co., Inc., 370 Seventh Avenue, New York.

You may send me on approval for 10 days' free examination, the STEINMETZ ELECTRICAL ENGINEERING LIBRARY. I agree to return the books, postpaid, in 10 days or to remit $4.00 in 10 days and $4.00 per month for eight months.

Name .....

Address .....

Official Position .....

Name of Company .....

Subscriber to Electrical World? .....Mem. A.I.E.E.? .....

(Books sent on approval to retail purchasers in U. S. and Canada only.) W. 6-28-24

Universal Service Switch

"Circle T" Universal Service Switches

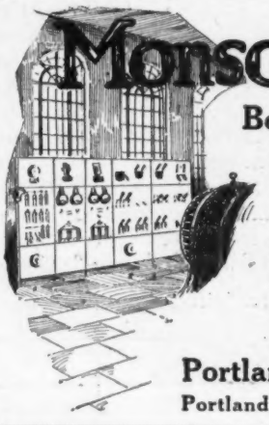
Standardized

Universal Service switches standardized. These new service switches combined in one cabinet, main service switch and distribution branch blocks for from one to four circuits.

Get Bulletin 56-A

The Trumbull Electric Mfg. Co.

Plainville, Conn.



Monson Slate

Best for Switchboards

Monson Slate is recognized throughout the industry for its uniform high quality.

To meet a rapidly increasing demand we have expanded our producing facilities to double their former capacity.

Users of Monson Slate are thus assured of prompt attention and service.

Let us tell you how Monson Slate will serve to enhance the quality of your products.

Portland-Monson Slate Co.

Portland, Me.—Quarries at Monson, Me.

WARD LEONARD VITROHM — VITREOUS ENAMELLED RESISTOR UNIT

Ward Leonard Electric Company

Mount Vernon, New York

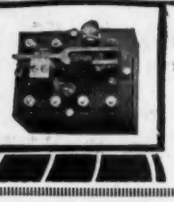
WARD LEONARD RIBOHM

Alligator Jaw Testing Clamps

suitable for every service requirement.

A. & J. M. Anderson Mfg. Co.

289-293 A Street, Boston, Mass.



Radio and Laboratory Instruments

Bulletin L

GENERAL RADIO CO.

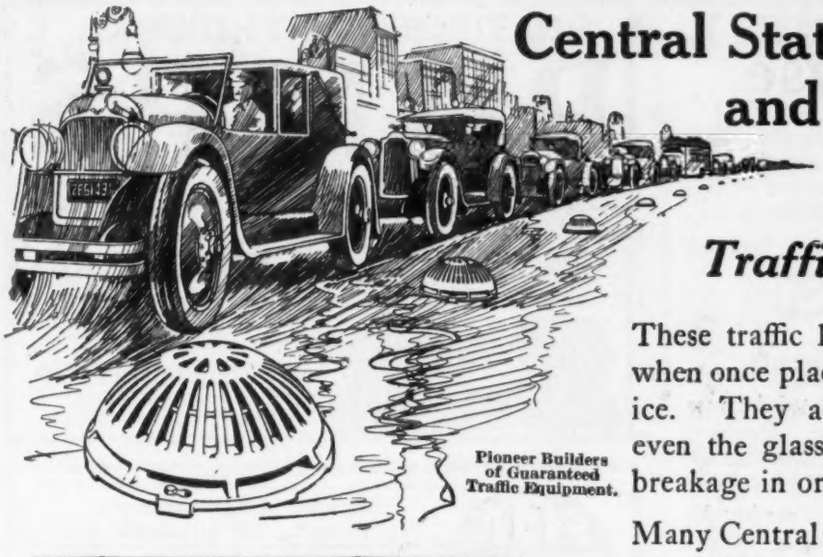
Cambridge 39, Mass 5312

SEMCO meters are BETTER WATTHOUR METERS

manufactured by

Sewickley Electric Mfg. Co.

Sewickley Penna.



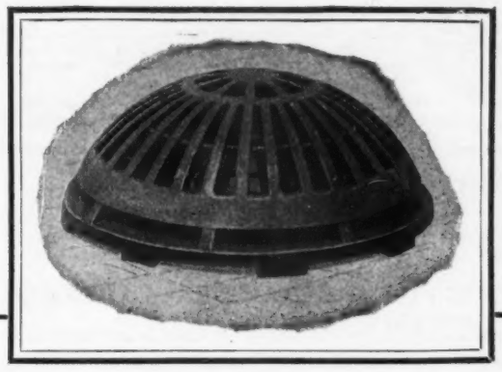
Pioneer Builders of Guaranteed Traffic Equipment.

Central Stations Make Money and Save Labor Costs

when "Mushroom" *Traffic Lights are Specified*

These traffic lights are easy to install and when once placed they give the utmost service. They are guaranteed throughout—even the glass bowl is guaranteed against breakage in ordinary service.

Many Central Stations have already investigated this new field. It means more power consumption and no loss in free service.



Essco Manufacturing Co.
113 W. Washington St., PEORIA, ILL.

MUSHROOM Traffic Lights
ESSCO - Stop and Go Signals

INVESTMENT BANKERS are offered POWER and LIGHT SECURITIES

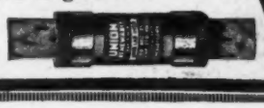
issued by companies with long records of substantial earnings.

We extend the facilities of our organization to those desiring detailed information or reports on any of the companies with which we are identified.

ELECTRIC BOND AND SHARE COMPANY
(Paid-up Capital and Surplus, $60,000,000)
71 Broadway, New York

Faradon
Reg. U. S. Pat. Off.
Static Condensers
All Dielectrics All Purposes
Wireless Specialty Apparatus Co.
Established 1907 Boston, Mass., U. S. A.

"UNION" FUSES
are made in both renewable and non-renewable types. Guaranteed to give satisfaction.
Booklet on request
CHICAGO FUSE MFG. CO.
Chicago New York



To Electrical and Radio Manufacturers

If you need clips as an accessory on your apparatus you can decide on

UNIVERSAL CLIPS

in the full confidence they are the generally recognized standard. This is evidenced by the fact they are now furnished on equipment made by—

Apco Manufacturing Co.
Crosley Radio Corp.
Fan Steel Products Co.
Federal Tel. & Tel. Co.
France Mfg. Co.
General Elec. Co.
Interstate Elec. Mfg. Co.
Sterling Mfg. Co.
Westinghouse Elec. & Mfg. Co.

On the market thirteen years.
Millions now in use.
Ask for sample.

Mueller Electric Co.
1570 East 31st Street Cleveland, Ohio

180,000 in use

The valuable information obtained from the chart records made by Bristol Instruments has become more and more recognized as absolutely imperative to efficient plant operation, hence the large number in use.

TRADE MARK

BRISTOL'S

REG. U. S. PAT. OFFICE.

Electrical Recording Instruments

Recording Ammeter for Wall or Switchboard

are invariably selected because of their extreme accuracy, simplicity and low maintenance cost.

The leading stations are installing Bristol's recording instruments. Hell Gate installed 39, Devon 34 and the new Brooklyn Edison Co's Hudson Station 20.

Bulletins L-306 and L-1501 will tell you how these instruments can increase your plant efficiency.

The Bristol Company

Waterbury, Conn.

Branch Offices:

Boston, Philadelphia, New York, Chicago, Detroit, St. Louis, Pittsburgh, San Francisco

RoTURBo CENTRIFUGAL

PUMPS

Manistee Iron Works Co., Manistee, Michigan

LECOURTENAY

CENTRIFUGAL PUMPS

LECOURTENAY CO.

26 MAINE STREET

NEWARK, NEW JERSEY

FOR Centrifugal PUMPS

See Our Advertisement in the First Issue of Each Month

CHICAGO PUMPS

Boiler Feed—House Service—Condensation Vacuum — Circulating — Sump (Vert.)— Sewage (Vert.)—Fire—Pneumatic System.

CHICAGO PUMP COMPANY

Office and Works, 2318 Wolfram St., Chicago, Ill.

Electric Smelting, Melting and Heat Treating Furnaces

"Greaves-Etchells" for Steel. "Elektrometall" for Ores
"Weeks" Rotating and "Gronwall" for Brass, etc.
"Electro" Steam Boilers

ELECTRIC FURNACE CONSTRUCTION CO.

1015 Chestnut Street, Philadelphia

Consulting Engineers on all electrical heating, annealing or melting problems.

The Taylor Stoker

The Simplest, Most Economic System of Combustion for Central Stations and Industrial Power Plants

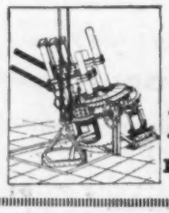
STOKER MANUFACTURERS ASSOCIATION SMA

American Engineering Company

Aramingo and Cumberland Sts., PHILADELPHIA, PA.

Manufactured in Canada by TAYLOR STOKER COMPANY, LTD., TORONTO, ONT.

Principal Sales Office: 416 *Phillips Place, Montreal, Quebec*



Moore Rapid Lectromelt Furnaces

Ten Standard Sizes ½ to 24 Tons Capacity
Most Rapid and efficient for making
Tool Steels, Alloy Steels, Forging Steels
Steel Castings, Malleable Iron, Grey Iron
Carbide, Ferro-Alloys etc.

PITTSBURGH ELECTRIC FURNACE CORPORATION
P.O. Box 1125. PITTSBURGH, PA.

DETROIT ELECTRIC FURNACES

will

Build Power Business

for

THE CENTRAL STATION

Let us help increase your revenue

Detroit Electric Furnace Co.

645 BOOK BLDG., DETROIT

Only reliable products can be continuously advertised

These Charts Cost $2000.00

They Show Valuable Data

Combustion Engineers spare no expense in securing facts

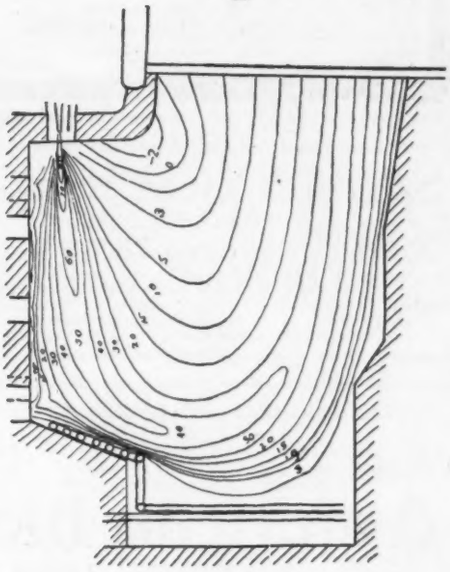


FIG. 1

Figure 1 shows furnace conditions as they relate to velocity of incoming coal and air. Along the front wall of the furnace, this velocity is extremely low and at no point is there an excessive velocity which might cause scrubbing and wearing away of the walls, nor is there a direct impingement.

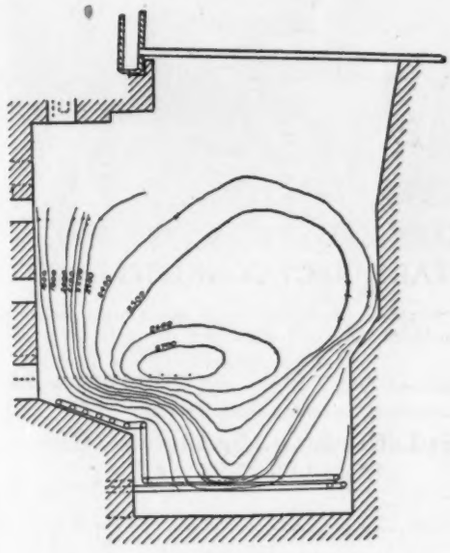


FIG. 2

Figure 2 relates to furnace temperatures. Against the walls there is a temperature of approximately 1,500 degrees. It may be noted that the highest temperature zone is a small zone of approximately 2,700 degrees in the center of the furnace away from both front and back walls, and in the other sectional view would not be within a dangerous proximity to the side walls.

Efficiencies and Economies of Lopulco Pulverized Fuel installations merit your careful investigation

Where results are checked LOPULCO Wins

INTERNATIONAL COMBUSTION ENGINEERING CORPORATION

Combustion Engineering Corporation

Combustion Engineering Bldg.—43 Broad Street New York City

Offices in Principal Cities Throughout the World

Frederick Multiple Retort Stoker
Type E Stokers
Type D Stokers
Type K Stokers
Type H Stokers

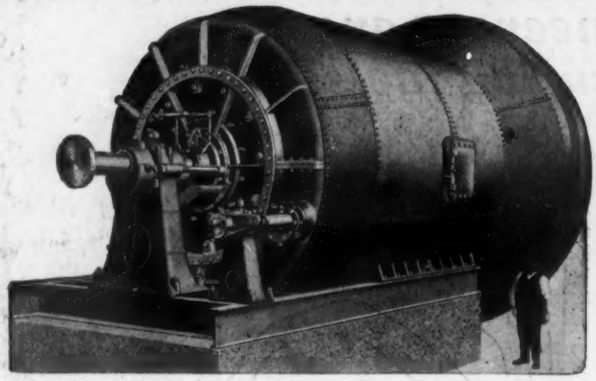
Self-Contained Stokers
Green Chain Grate Stokers
Green Cast Iron Hoppers
Green Pressure Waterbacks
Quinn Fuel Oil Equipment

Lopulco Pulverized Fuel Systems
Coxe Stokers Grieve Grates
Air Heaters
CEC Tube Scraping Device
Combusco Water Steel Conveyors

LEFFEL

TURBINE WATER WHEELS

HIGH SPEEDS, HIGH POWERS, HIGH EFFICIENCES



HORIZONTAL DIRECT CONNECTED UNIT

We construct many large vertical and horizontal turbines developing speeds, powers and high efficiencies to meet requirements.

We Fully Guarantee Our Turbines and Results Developed.

Bulletins Forwarded Upon Request

The James Leffel & Co., Springfield, Ohio

BRANCH OFFICES:

NEW YORK, N. Y. ..... 39 Cortlandt St.
BOSTON, MASS. ..... 80 Boylston St.
ATLANTA, GA. ..... 4th Nat'l Bank Bldg.
MINNEAPOLIS, MINN. ..... Plymouth Building
LANCASTER, PA. ..... Woolworth Bldg
PETERBOROUGH, ONT., CANADA ..... William Hamilton Co., Ltd.

DEAN

ELECTRIC CONTROL UNIT
For the Motor Operation of Large
GATE AND GLOBE VALVES
Write for Bulletins
PAYNE DEAN LIMITED
Stamford, Conn.
CHICAGO NEW YORK PITTSBURGH

SANFORD RILEY STOKER CO.

WORCESTER, MASS.

"RILEY" Underfeed Stokers "JONES" Underfeed Stokers
"MURPHY" Automatic Furnaces

Boston New York Philadelphia Pittsburgh Buffalo
Cleveland Detroit Cincinnati Chicago
Underfeed Stoker Co. of Canada, Ltd., Toronto.

STANDARDIZED OR SPECIALLY DESIGNED EQUIPMENT

Mechanical Draft Ventilating Fans Steam Traps
Generator Cooling Steam Engines Heating Systems
Complete Engineering Service (253)

American Blower

"Sirocco" TRADE MARK

AMERICAN BLOWER COMPANY, DETROIT

THE BABCOCK & WILCOX COMPANY

85 LIBERTY STREET, NEW YORK

Builders since 1868 of Water Tube Boilers of continuing reliability

BRANCH OFFICES

BOSTON, 49 Federal Street
PHILADELPHIA, North American Building
PITTSBURGH, Farmers Deposit Bank Building
CLEVELAND, Guardian Building
CHICAGO, Marquette Building
CINCINNATI, Traction Building
ATLANTA, Candler Building
PHOENIX ARIZ., Heard Building
DALLAS, TEX., 2001 Magnolia Building
HONOLULU. H. I., Castle & Cooke Building
PORTLAND, ORE., 805 Gasco Building

THE BABCOCK & WILCOX COMPANY — STEAM

WORKS

Bayonne, N. J.
Barberton, Ohio

Makers of Steam Superheaters since 1898 and of Chain Grate Stokers since 1893

BRANCH OFFICES

DETROIT, Ford Building
NEW ORLEANS, 521-5 Baronne Street
HOUSTON, TEXAS, Southern Pacific Building
DENVER, 435 Seventeenth Street
SALT LAKE CITY, 705-6 Kearns Building
SAN FRANCISCO, Sheldon Building
LOS ANGELES, 404-6 Central Building
SEATTLE, L. C. Smith Building
HAVANA, CUBA, Calle de Aguiar 104
SAN JUAN, PORTO RICO, Royal Bank Building

Use the Coupon

Gentlemen: Without obligation on my part I would like to read your Bulletin No. 6.
Name .....
Business Address .....
Home Address .....
Date .....
By .....

Wickes Horizontal Cross Drum Water Tube Boiler

No wrapper sheet in header.

No riveted joint on fire side of header or buried in brickwork.

The one riveted joint in header visible at all times.

THE WICKES BOILER CO.

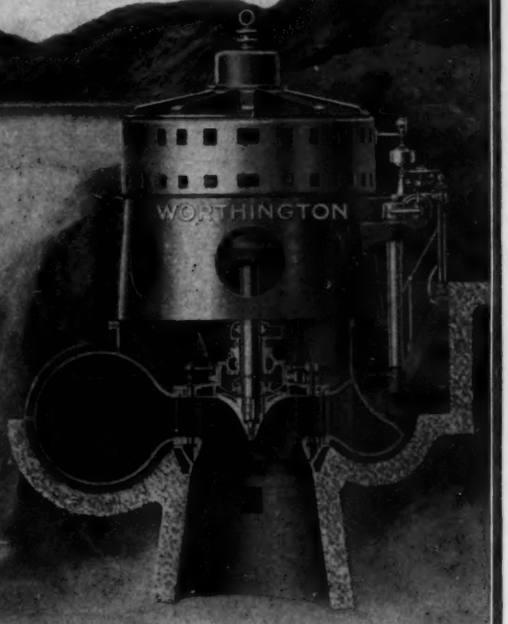
Saginaw, Michigan

SALES OFFICES:

Pittsburgh, 1218 Empire Bldg. New York, 501 Fifth Ave.
Detroit, 1116 Penobscot Bldg. Chicago, 76 West Monroe St.
Seattle, 736 Henry Bldg.

Standardized High Head Turbines

One of the seven Worthington standardized high head water turbines that cover practically every normal requirement. The Worthington Water Power Equipment bulletin has an interesting story about Standardized Turbines; have you read it? W-185-A



WORTHINGTON

WORTHINGTON PUMP AND MACHINERY CORPORATION

Executive Offices: 115 Broadway, New York City. Branch Offices in 24 Large Cities.

HYDRAULIC TURBINES

THE PELTON WATER WHEEL CO.

Hydraulic Engineers

1995 Harrison Street, San Francisco; 100 Broadway, New York.

Steam Turbines

(Curtis type)

Use them for auxiliaries also.

GENERAL ELECTRIC COMPANY

Schenectady, N. Y. 31-45

Steam Turbines, for all speed and steam conditions; capacities up to 15,000 hp. Catalog D43.
Double Helical Speed Reducing Gears, Catalog G43
Centrifugal Pumps, for all Capacities. Catalog P43.
Centrifugal Blowers and Compressors. Catalog F43

De Laval

Steam Turbine Company, Trenton, N.J.

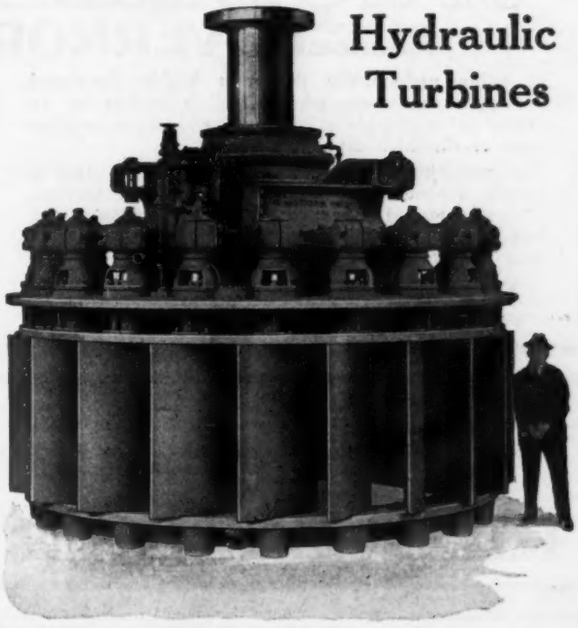
The TERRY TURBINE

The Turbine known for its efficiency, dependability and simplicity. More than 9000 in operation. Write for Catalog

THE TERRY STEAM TURBINE CO. HARTFORD, CONN.

SMITH

Hydraulic Turbines



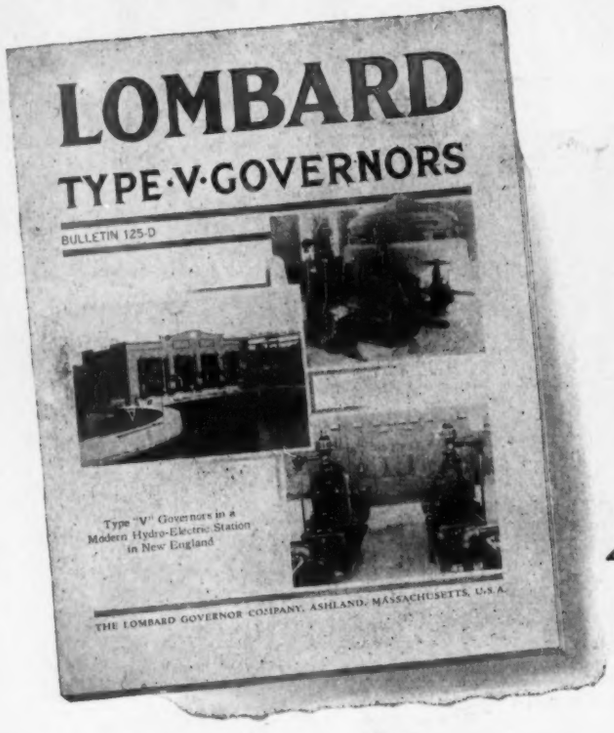
One of seven Single Runner, Vertical Shaft Hydraulic Turbine Units recently furnished Southern Power Co. Charlotte, N. C. for installation at Mountain Island, N. C. and Great Falls, S. C.

S. MORGAN SMITH CO., York, Pa.

BRANCH OFFICES:

BOSTON 176 Federal St. | CHICAGO 76 W. Monroe St. | MONTREAL 405 Power Bldg.

THE PACE IS SET


LOMBARD
TYPE·V·GOVERNORS
BULLETIN 125-D
Type "V" Governors in a Modern Hydro-Electric Station in New England
THE LOMBARD GOVERNOR COMPANY, ASHLAND, MASSACHUSETTS, U.S.A.

In thousands of hydro-electric power plants all over the world the closest speed regulation is maintained reliably and consistently, day after day, by Lombard hydraulic governors.

In our long years of experience since the days when we pioneered the development of the hydraulic type, we have built many types for about every condition of service.

We can help you, too.

← *Send for this Bulletin.*

THE LOMBARD GOVERNOR CO.
250 MAIN STREET
ASHLAND, MASSACHUSETTS

The **WOODWARD**
OIL PRESSURE GOVERNOR

Is today undoubtedly the most highly developed Governor for water wheels and is backed by an organization capable of meeting any special requirement or condition that may arise.

The profitable operation of a hydro-electric plant is largely dependent on the governing of the turbine. The selection of Woodward Governors insures the best results from the start, prompt service and freedom from expensive delays.

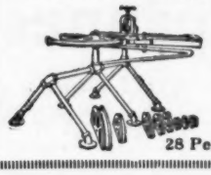
Woodward Governor Company
Rockford, Illinois

SCOVILL CONDENSER TUBES LAST LONGER

Use Cup Drawn Admiralty for Salt Water
Use Scovil Special Muntz for Fresh Water

SCOVILL MFG. CO., WATERBURY, CONN.

"Wonder" Cold Pipe, Tubing and Bar Benders



Standard of the World
HAND AND MOTOR OPERATED
14 Sizes of Machines
What it costs to bend pipe our way. Per Bend:
1-in. pipe, 5 cents 4-in. pipe, 25 cents
2-in. pipe, 10 cents 6-in. pipe, 60 cents
8-in. pipe, $1.00
Send for Catalogue
American Pipe Bending Machine Co.
28 Pearl St., Boston, Mass. *One Year to Pay*

USE A FOUR-VALVE ENGINE

in plants up to 500 kw. capacity with moderate steam pressures and if you use most of the exhaust.

See our page, June 7.

RIDGWAY DYNAMO & ENGINE CO.
RIDGWAY, PA.

Waverly ALL PENNSYLVANIA **LUBRICATION**
REFINED FROM
All Pennsylvania Crude
Write for Industrial Oil and Grease Charts
Waverly Oil Works Company
5600-54th ST., PITTSBURGH, PA.
Ask the Man who uses "Waverly"

—a manufacturer
in Newark, N. J.
—saved $200
buying from an Indiana dealer in
—second-hand machinery
through his advertising in the
—searchlight section

It pays
to read the Searchlight.
It pays
to advertise in the Searchlight.

0058

Are you interested in fuel saving?

—here are two books that show you how

These books are not only interesting—they explain facts of vital importance to every executive and engineer.

The Foster Superheater Book shows how superheat is saving from 10 to 30 per cent of the steam used in thousands of plants of every type and size, and explains the many additional advantages of superheated steam.

The Foster Economizer Book shows how the Foster Economizer recovers heat being lost in the smoke stack and increases boiler capacity as well.

Use the coupon below for a copy of each of these books—they will point the way to worth-while economies in your plant.

POWER SPECIALTY COMPANY
111 Broadway, NEW YORK

Boston, Philadelphia, Pittsburgh, Kansas City, Chicago, San Francisco, Dallas, Detroit, Boulder, London, Eng.

FOSTER

SUPERHEATERS ECONOMIZERS

Power Specialty Co., 111 Broadway, N. Y.

You may send me the books on Foster Superheaters and Economizers.

Name.....

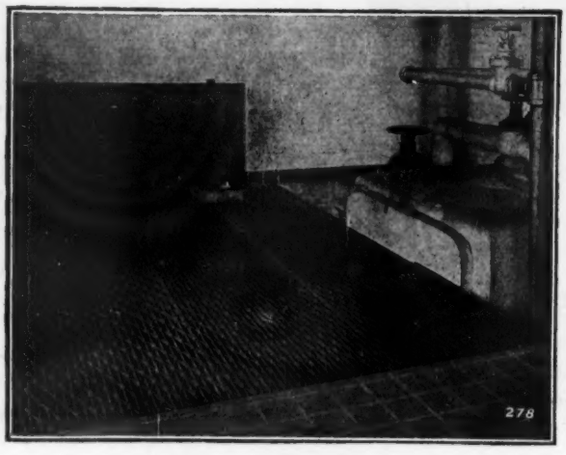
Address.....

EW 6-28-24

IRVING PATENTED TRADE MARK SUBWAY REG. U.S. PAT. OFF.

THE FIREPROOF OPEN STEEL FLOORING

Foot comfort is a mighty big thing, with the man who spends his days on his feet—standing or walking or working or wheeling a load. Give him a floor of ***Irving Subway,*** and you've given him foot comfort—because the ***Subway*** surface is smooth but non-slipping, always. And if he works in hot, close quarters, he'll welcome the cooling, invigorating ventilation afforded by that 80 open floor space. These things react on your people—in more work and better work from each man. Have you read Catalog 4A4?

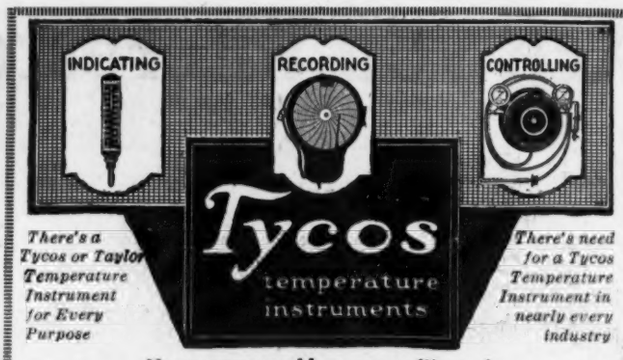


IRVING IRON WORKS CO.
LONG ISLAND CITY, N.Y., U.S.A.

Manufacturers also of

IRVING SAFSTEP TRADE MARK PATENTED REG. U.S. PAT. OFF.
ABSOLUTELY NON-SLIPPING ALWAYS

INDICATING RECORDING CONTROLLING



There's a Tycos or Taylor Temperature Instrument for Every Purpose

Tycos temperature instruments

There's need for a Tycos Temperature Instrument in nearly every industry

Name your problem—we will send the catalog that will help you most.

Taylor Instrument Companies ROCHESTER, N. Y.
Canadian Plant, Tycos Building, Toronto

ELECTRIC CRANES
HAND CRANES
ELECTRIC HOISTS
I-BEAM TROLLEYS

SEND FOR BULLETINS

MARIS BROS., Philadelphia

NORTHERN CRANES

NORTHERN ENGINEERING WORKS
214 Chene St., Detroit, Mich.

HAYWARD

Orange Peel, Clam Shell, Electric Motor, and Drag Scraper Buckets for all excavating, digging and rehandling purposes. Ask for Catalog 43, or consult our engineers gratis.

The Hayward Co., 50-60 Church St., N. Y.

BUCKETS

HIGH SPEED
ARMATURE NOTCHERS
400 STROKES PER MINUTE
FERRACUTE MCH. CO., BRIDGETON, N. JERSEY, U.S.A.

"POSITIONS VACANT"

Good jobs appear under this heading in the

"SEARCHLIGHT SECTION"

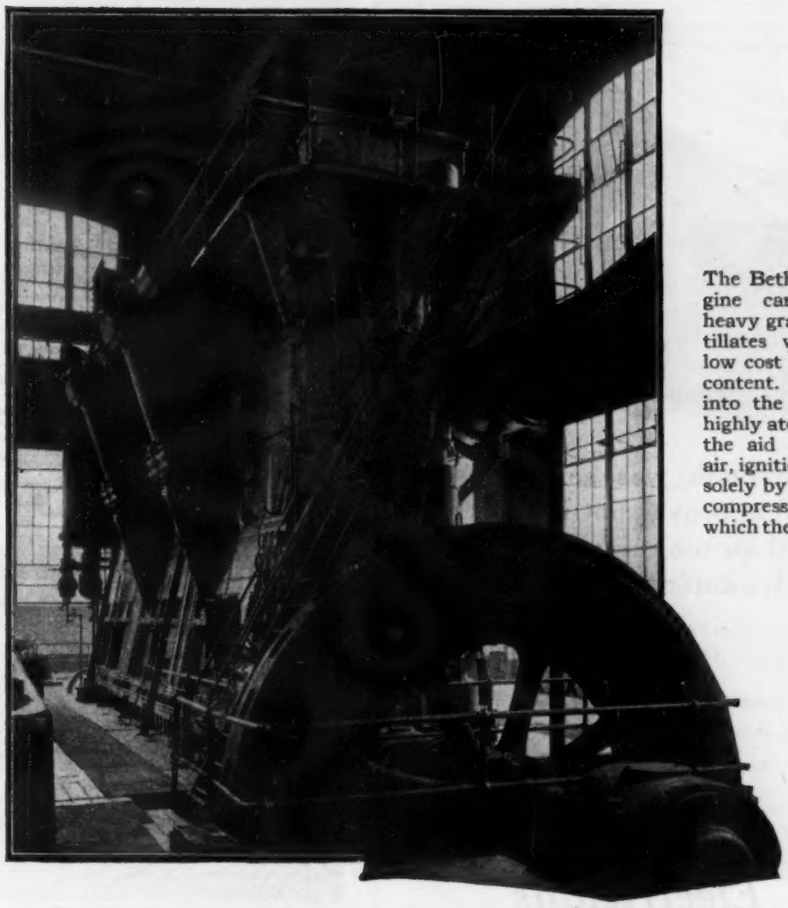
EMPLOYERS! *Use* these columns for good men.

MEN! *Consult* these columns for good jobs.

8 cents a word. *Minimum $2.00 an insertion.*

0130

Built in units of 2, 4, 6 and 8 cylinders



The Bethlehem Oil Engine can handle the heavy grades of fuel distillates which combine low cost with high heat content. Fuel is injected into the cylinders in a highly atomized state by the aid of compressed air, ignition being caused solely by the heat of the compressed air into which the fuel is injected.

Oil engine power is *modern power!*

BECAUSE the oil engine meets every demand of the modern power user at a lower total cost than any other power source.

The Bethlehem Oil Engine furnishes thoroughly satisfactory power at a saving of two-thirds to one-half the fuel cost of a modern steam plant. It has the additional advantage of simplicity. A single, compact unit replaces the boilers, numerous separately-driven auxiliaries, coal- and ash-handling machinery, of the steam plant.

The power user who installs the Bethlehem Oil Engine has the advantage of having his own power plant, which he can operate to suit his requirements. He is independent of outside power sources and, at the same time, his oil engine plant supplies power at a cost considerably below the cost of purchased power.

In the Bethlehem Oil Engine, power users have available an engine of exclusively American design, developed to meet the exacting requirements of American practice. Severe and prolonged tests have amply proved its thoroughly satisfactory operation and its high fuel economy.

BETHLEHEM STEEL COMPANY, General Offices, BETHLEHEM, PA.

Sales Offices in Boston, New York, Philadelphia, Baltimore, Washington, Atlanta, Pittsburgh
Buffalo, Cleveland, Detroit, Chicago, Cincinnati, St. Louis, San Francisco

BETHLEHEM OIL ENGINE *Large Unit Type*

"The book was sent on ten days' approval but it took me less than ten minutes to know that I wanted it."

That's what one man wrote us about the CROFT HANDBOOK.

This book has become world-famous as the one great pocketbook of practical electricity.

CROFT'S

American Electricians' Handbook

BY TERRELL CROFT

823 pages, flexible, pocket size, 900 illustrations. $4.00 net, postpaid.

The latest information on practical electricity. The book is brimful of those facts which every man engaged in electrical work needs to know.

Think how much help you would be able to get from a convenient pocket-size handbook that gives you in one book

Practical suggestions for locating and correcting both motor and generator troubles—
Clear directions for proper installation and operation of motors and generators—
Explanations of fundamentals of practical electricity—
Helpful data on transformers—
All the details the practical man needs on wiring for light and power.

All these topics and many more are covered in this new revised second edition of **Croft's Handbook.**

Examine it for 10 days FREE

McGRAW-HILL

FREE EXAMINATION COUPON

McGraw-Hill Book Co., Inc., 370 Seventh Ave., New York.
You may send me on 10 days' approval **Croft's American Electricians' Handbook, new Second Edition, $4.00 net, postpaid.** I agree to remit for the book or return it postpaid within 10 days of receipt.

.....I am a regular subscriber to Electrical World.

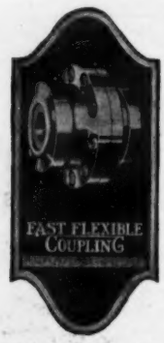
Signed .....
(Please Print)

Address .....

Official Position.....

Name of Company.....
(Books sent on approval to retail purchasers in the U. S. and Canada only.) W. 6-28-24

A *Lubricated* All Metal Flexible Coupling



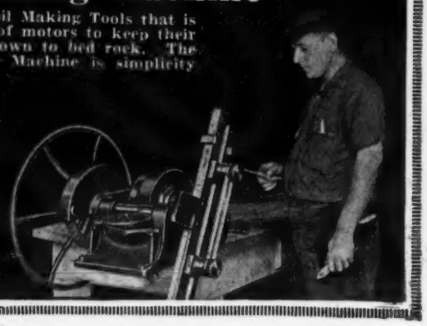
Send for Catalog

***The* BARTLETT HAYWARD CO.**
Baltimore, Maryland

SEGUR

Coil Winding Machine

One of the Segur Coil Making Tools that is helping large users of motors to keep their maintenance costs down to bed rock. The Segur Coil Winding Machine is simplicity itself regardless of the type of coil it is called upon to wind. Send for Segur data sheets.



Electric Service Supplies Co.
Manufacturers, Jobbers, Exporters
Philadelphia, New York, Chicago, Boston, Pittsburgh, Scranton

a directory—
an encyclopedia—
a data book—
a "who's who"—
a mailing list—
a handbook—

of 6,750 electric light, power and transmission companies in America—

that's what you get in the new 1924 McGraw Central Station Directory and Data Book. It contains over 70,000 changes and additions to the data in the last edition. Let us send you a copy.

Directory Dept.,
Electrical World,
471 Tenth Avenue, New York City.

Send me a copy of the new 1924 Edition of the McGraw Central Station Directory and Data Book. I agree to send you $20, the price of the book, upon receipt of your bill.

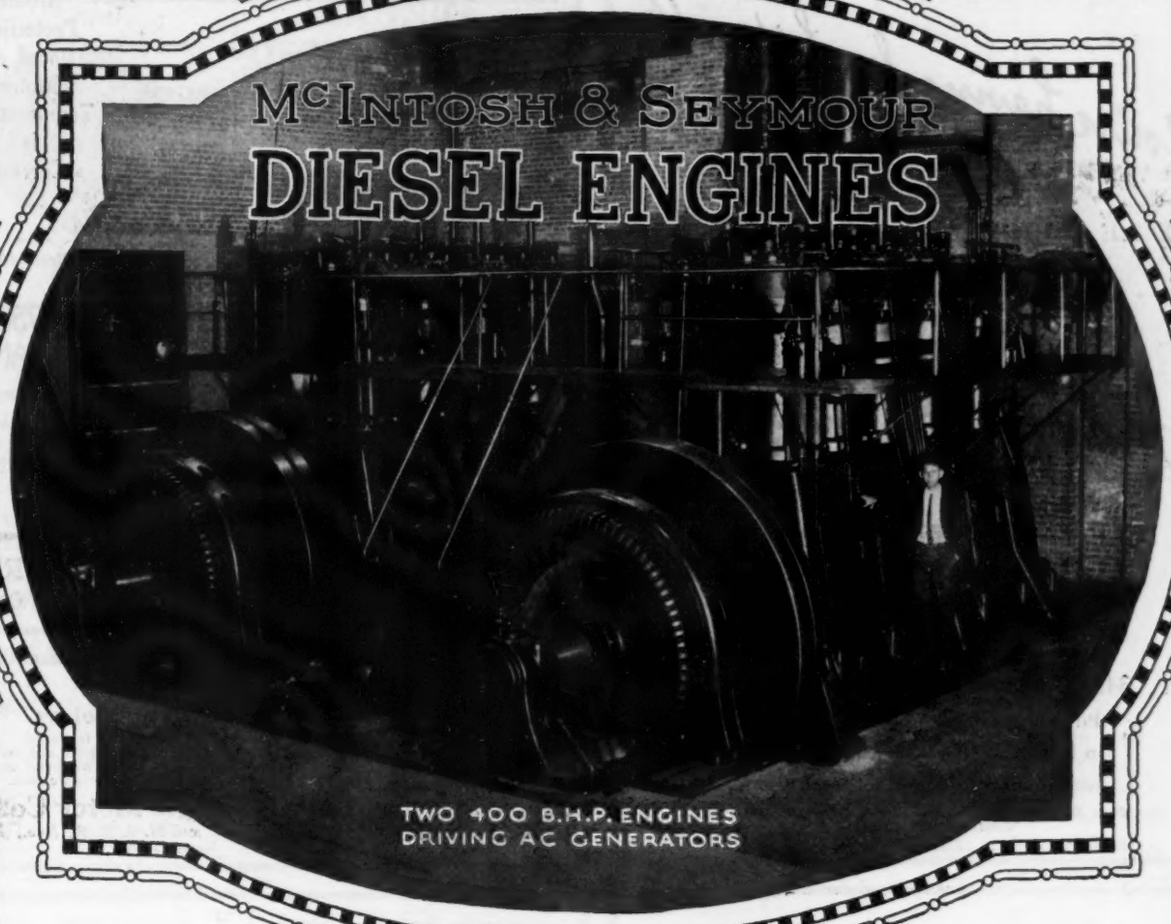
Name .....

Position .....

Company .....

Address .....

.....



What does a K.W. Hr. cost you?

Reducing the cost of power from 6.03c. per K.W. hour down to 0.94c. per K.W. hour is no small achievement. The two 400 B.H.P. McIntosh & Seymour Diesel Oil Engines shown above did this at the Arkansas-Missouri Power Company's Plant at Caruthersville, Mo., in the first year of operation. Below are given comparative costs:

COMPARATIVE COSTS

	STEAM PLANT	McINTOSH & SEYMOUR DIESEL PLANT
OPERATION		
Boiler Room	$ 375.00	0
Fuel	(Coal) 2,563.36	(Oil) $851.20
Unloading Coal	20.00	0
Wages, (including ice pullers)	444.95	287.77
Lubrication, waste, etc.	138.77	175.15
MAINTENANCE		
Building	0	21.47
Boilers	36.75	.....
Engines (including spares)	9.40	356.40
Tools	10.51	.82
TOTAL	$3,618.64	$1,692.71
PERFORMANCE TOTAL K.W. HRS.	60,000	181,420
COST PER K.W. HR.	6.03 cents	0.94 cents

McINTOSH & SEYMOUR CORPN

MAIN OFFICE AND WORKS AUBURN, NEW YORK, U. S. A.

SALES OFFICES AT

149 BROADWAY NEW YORK CITY — 412 BISBEE BLDG. JACKSONVILLE, FLA. — 1016 BALTIMORE, AVE. KANSAS CITY, MO. — 330 HUMBLE BLDG. HOUSTON TEXAS — 815 SHELDON BLDG. SAN FRANCISCO, CAL.

You're having brush trouble

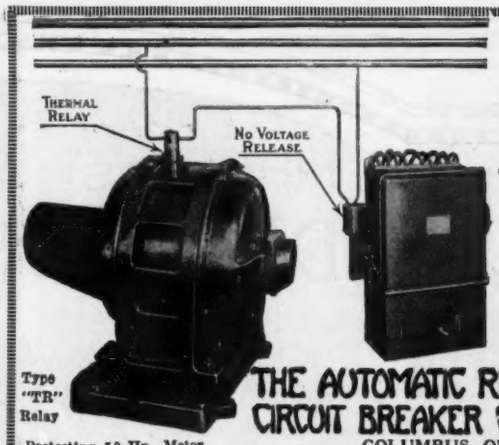
CORRECT IT

USE LE CARBONE CARBON BRUSHES

They talk for themselves

COST MORE PER BRUSH
COST LESS PER KW.H.

W. J. Jeandron
343 Madison Avenue, New York
Pittsburgh Office: 634 Wabash Bldg.
San Francisco Office: 525 Market Street
Chicago Office: 1657 Monadnock Block
Canadian Distributors: Lyman Tube & Supply Co., Ltd., Montreal and Toronto

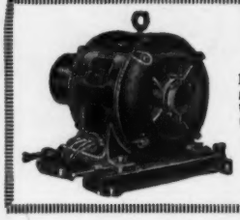


Motor Protection Based on Motor Temperature is Correct

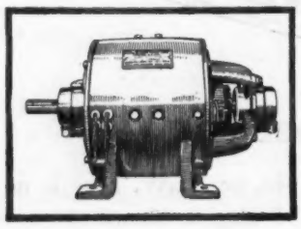
See Bulletin 402-B

THE AUTOMATIC RECLOSING CIRCUIT BREAKER COMPANY
COLUMBUS, OHIO

IMPERIAL
MOTORS · GENERATORS
Imperial Electric Co. Akron, Ohio



STAR
Ball Bearing Motors
Direct and Alternating Current up to 75 hp. Also generators and alternators in horizontal and vertical types, and motor generator sets. We build motors to meet your requirements. *Ask for more data.*
Star Electric Motor Co.
Miller St. and N. J. R. R. Ave., Newark, N. J.



A special motor—
minus costly specialization

Zobell Electric Motors can be furnished to meet special requirements at quantity production prices, even in limited quantities.

They utilize standard, interchangeable parts, manufactured on a quantity production basis.

These parts used in various combinations enable us to build up motors to meet a wide range of mechanical and electrical requirements—without the costly development usually involved.

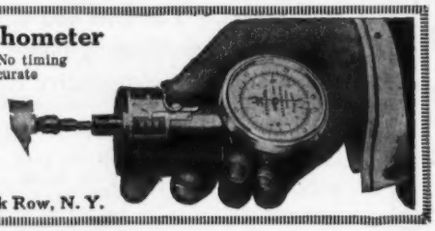
D. C. and A. C. Squirrel Cage and Slip Ring Motors.

Write for Bulletin

Zobell Electric Motor Corporation
Garwood, N. J., U. S. A. 2007-32

Shelton Write for Catalog of Shelton Specialties
Shelton Electric Co.
New York Chicago
Boston San Francisco
Vibrators

O-Z Hand Tachometer
Speeds at a glance. No timing
"Dead Beat" Accurate
Hand Tachograph
Draws graphic charts of speeds—30-24,000 R.P.M.
Circulars on request
O. Zernickow, 13 Park Row, N. Y.



WASHERS—That's Us
Brass, Steel and Copper Washers.
Flat, Bevelled or Countersunk.
Special Sizes and Shapes.
Prompt Deliveries. Let us have your inquiry.
Massachusetts Machine Shop, Inc.
817 Albany St., Boston, Mass.

Only reliable products can be continuously advertised

JEANNIN
SINGLE PHASE
REPULSION
INDUCTION
MOTORS

¼ to 5 H. P.

THE JEANNIN ELECTRIC CO.
Toledo, Ohio

Baldor Electric Motors
Ball Bearing

Single Phase Repulsion Type
Direct Current
Polyphase

Horizontal and Vertical Design.
Semi and Totally Enclosed Back Geared

Superior in Quality. Competitive in Price.

BALDOR ELECTRIC CO.
4351-55 Duncan Ave. St. Louis, Mo.

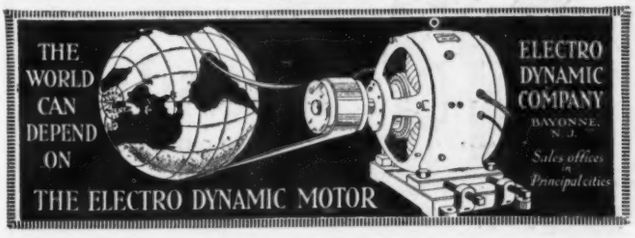
Sturtevant Electric Motors
Direct and Alternating Current
Single and Polyphase
Generators and Generating Sets

B. F. Sturtevant Company
Hyde Park, Boston, Mass.

Commutators and Commutator Segments
for Electric Starters and Lighters and all other types of D. C. Motors

THE CAMERON ELECTRIC MFG. CO.
Ansonia, Conn.

ROME Quality BRASS COPPER BRONZE
Electrical Copper Commutator Segments.
ROME BRASS & COPPER COMPANY · ROME N.Y.


THE WORLD CAN DEPEND ON
THE ELECTRO DYNAMIC MOTOR
ELECTRO DYNAMIC COMPANY
BAYONNE, N. J.
Sales offices in Principal cities

Ama Ganda

Among the Kaffirs it is not thought wise for a woman to eat too many eggs (ama ganda).

For they consider eggs a semi-mystery.

And even in this country eggs are regarded as a semi-mystery.

Carbon brushes too.

In a great many instances we never know the content of either until we get on the inside.

In a very few instances we do know—one being Morganite—in which you get good ingredients—uniformly.

Another thing the brush has in common with the egg:—*parts* of it can't be good.

It's either all good or—

Morganite Brush Co., Inc.

Main Office and Factory:
519 West 38th St., New York

DISTRICT ENGINEERS AND AGENTS

Railway & Power Engineering Corp. Ltd.
326 Craig Street, West
Montreal, Canada

Railway & Power Engineering Corp. Ltd.
P. O. Box No. 325
Winnipeg, Canada

Century

Type AS Induction POLYPHASE MOTORS

Ratings ½ to 60 h.p.

are designed to be started by using a single throw switch; thereby eliminating the customary starting auxiliaries necessary with most types of three phase motors. The starting current is low, and cannot be varied by the operator; besides fuses which will protect the motor while carrying its load will usually effect a start. They are especially well adapted to the operation of refrigerating machinery, pumps, and remote control installations.

Temperature Rise Not More Than 40° Centigrade

Century Electric Company

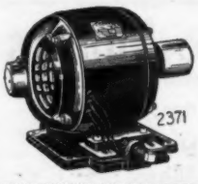
General Offices: 1827 Pine St.

St. Louis, Mo., U. S. A.

Sales Offices and Stocks in Principal Cities

REYNOLDS ELECTRIC COMPANY
2644 W. CONGRESS STREET CHICAGO, ILL.

MOTORS ½20 TO ¼ H.P. A.C. AND D.C.
MANUFACTURERS OF
FLASHERS FOR ELECTRIC SIGNS TRAFFIC SIGNALS, ETC.
COLOR HOODS FOR SIGN LAMPS
MIXERS FOR BAKE SHOPS HOTELS, ETC.
REFLECTORS FOR POSTERS, BULLETINS, ETC.



Emerson Motors—Fans
A.C. and D.C. Motors 2 hp. and smaller
A.C. and D.C. Fans of all types
Stocks at St. Louis, New York and with jobbers at convenient points.
The Emerson Electric Mfg. Co.
2018 Washington Avenue, St. Louis, Mo.
50 Church St., New York City
The Emerson Company Sells No Apparatus at Retail

We specialize in motors, ⅓ to 150 hp. constant and adjustable speed D.C.; squirrel cage and slip ring A.C.

RELIANCE MOTORS

Reliance Electric & Engineering Co., 1046 Ivanhoe Rd., Cleveland, O.

MARBLE-CARD MOTORS
D. C. and A. C., Ball Bearing Motors of the medium commercial sizes. D. C. machines up to 75 HP. with Commutating Poles. Get Bulletin No. 200.
A. C. Machines up to 25 HP. All standard speeds and voltages. Get Bulletin No. 300.
Special machines built to meet your needs. Full details cheerfully supplied. Write
Marble-Card Electric Company
Gladstone, Mich.

BURKE ELECTRIC CO.
ERIE, PA
Motors, Alternators, Generators, Motor Generator Sets, Transformers, Arc Welding Equipment
Sales Offices: Buffalo, Cleveland, Detroit, Erie, New York, Philadelphia, Pittsburgh, Chicago
Sales Agencies: Underwood Electric Co., Cincinnati; W. T. Osborn, Kansas City; Coast Equipment Company, San Francisco, Cal.

Advertisements for the
Searchlight Section

Can be received at the New York Office of Electrical World until 10 a.m.

Tuesday

For Issue out Saturday

0139

COLONIAL
Fans—Motors—Generators
FAN & MOTOR CO. WARREN, O.

Our Customers Wrote this Ad.

Compressor duty is very hard on motors, but when we ship an air compressor we know our customers will not have any motor trouble. Our tests with Master Motors prove this.

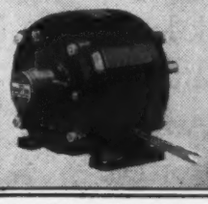
Master Motors are the coolest running motors we have ever used. Although often subjected to severe operating conditions, they are giving very good service.

We are much pleased with the service you are giving us and find that your motors do our work better than any motor we ever had on our compressors.

We have tried out your motors as well as other motors and have decided as a result of our tests to use Masters on our pneumatic pumps.

Wouldn't you like to test a Master Motor on your product? We'll gladly send them to responsible manufacturers. Write us about it today

THE MASTER ELECTRIC CO. 438 First St., Dayton, Ohio



MASTER
40° GUARANTEED
MOTORS
¼ to 1½ H.P.—A.C. and D.C.

MORSE SILENT CHAIN DRIVES

MORSE CHAIN CO., ITHACA, N. Y.

Consult the Morse Engineer in your territory

ATLANTA, GA. BALTIMORE, MD. BOSTON, MASS. CHARLOTTE, N.C. CHICAGO, ILL. CLEVELAND, OHIO DENVER, COLO. DETROIT, MICH. KANSAS CITY, MO. NEW YORK CITY MINNEAPOLIS, MINN. MONTREAL, QUE. CAN. PHILADELPHIA, PA. PITTSBURGH, PA. SAN FRANCISCO, CAL. ST. LOUIS, MO. TORONTO, ONT., CAN. WINNIPEG, MAN., CAN.

Positive as gears, flexible as belts, combining advantages of both without disadvantages of either.

2151-30

TRIUMPH MOTORS

Type "TR" Slip Ring Squirrel Cage Direct Current

The Triumph Electric Co., Cincinnati, O.
Builders of Motors Since 1892

DIEHL—ELECTRICAL—APPARATUS

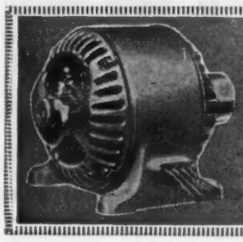
Alternating and Direct Current

FANS—MOTORS—GENERATORS

DIEHL MANUFACTURING COMPANY

Elizabeth, New Jersey

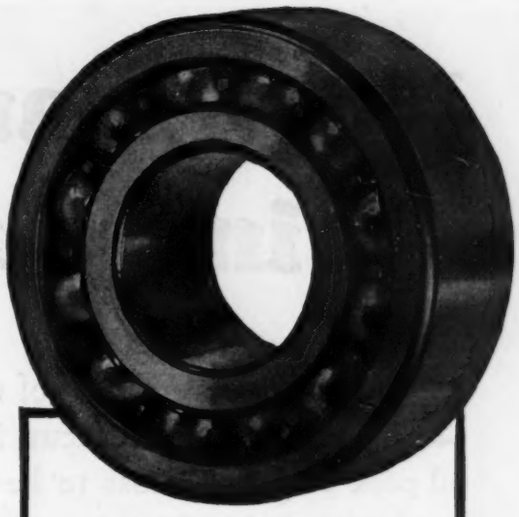
Boston Chicago New York Philadelphia



Peerless MOTORS AND GENERATORS

SATISFACTION to every USER

Peerless Electric Co.
WARREN OHIO



THE faultless performance of SRB Bearings in electric motors is achieved by the utmost vigilance and thoroughness in every step of fabrication under the supervision of SRB Engineers.

For example, the High Carbon Chromium Steel from which the inner and outer rings and balls are made undergoes rigid inspection, analysis and tests before use, while the secret of exceptional smoothness—an outstanding characteristic of all SRB Bearings—is gained through the most careful and correct grinding. And finally, each finished bearing is given the final SRB test to assure its long lasting qualities.

STANDARD STEEL AND BEARINGS INCORPORATED.

Plainville, Connecticut

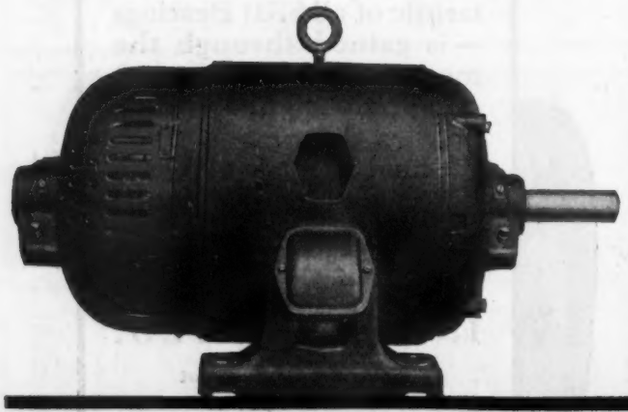
How many motors in your peak load?

THE poor power-factor of motor load even though it occurs in the off-peak period is a loss to be reckoned with. It requires more machinery in operation than would otherwise be necessary, increases the line loss and complicates voltage regulation.

But, how many peak loads are all lighting loads? Even in summer, with daylight saving in operation, there are some motors running overtime, and some that always run at night. And in winter the lights come on before the motors stop. Then is the time when the power-factor shoe pinches most.

If those late-running motors were FYNN-WEICHSEL Motors, you would not need to worry about power-factor at your peak load—nor about overloaded generators, cables or transformers with power still in reserve at the turbine throttles.

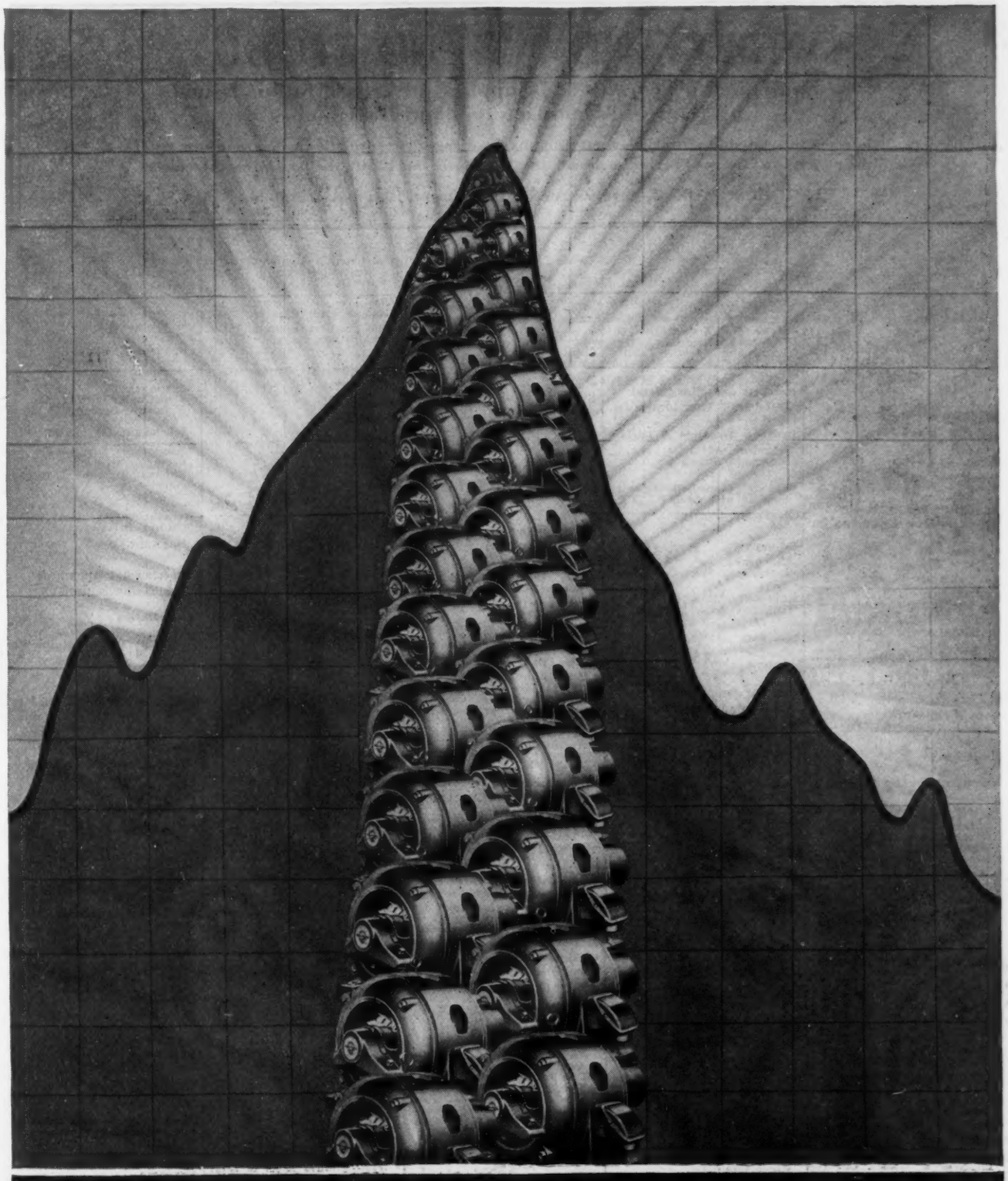
The FYNN-WEICHSEL MOTOR CORRECTS POWER-FACTOR.



WAGNER ELECTRIC CORPORATION
Wagner Quality
SAINT LOUIS, U.S.A.

Fynn-Weichsel

The motor that corrects power-factor



WAGNER ELECTRIC CORPORATION
SAINT LOUIS

WAGNER ELECTRIC CORPORATION

You may send me—without obligation on my part—a copy of your bulletin No. 134, describing THE FYNN-WEICHSEL MOTOR.

NAME

COMPANY

STREET

CITY STATE

WHAT AND WHERE TO BUY

Equipment, Apparatus and Supplies Advertised in this Issue with Names of Manufacturers and Distributors

Readers interested in any articles not listed in these pages are cordially invited to inform us of their wants and every effort will be made to put them in touch with the proper manufacturers.

ELECTRICAL WORLD, Readers' Service Department, 10th Ave. & 36th St., N. Y. C.

Air Compressors
Allis-Chalmers Mfg. Co
General Electric Co.
Ingersoll-Rand Co.
Nordberg Mfg. Co.
Westinghouse Elec. Mfg. Co

Air Washing & Conditioning Apparatus
American Blower Co.
Sturtevant Co., B. F.

Alternators
Burke Elec. Co.

Anchors, Guy
Matthews Corp., W. N.

Armature Repair Machy.
Electric Service Supplies Co

Asbestos
Boiler and Pipe Covering
Johns-Manville, Inc.
Ebony Wood
Johns-Manville, Inc.
Niagrite Cable Protection
Johns-Manville, Inc.
Paper Tape
Johns-Manville, Inc.
Transite Wood
Johns-Manville, Inc.

Bars, Reinforced
Pacific Coast Steel Co.

Batteries
Dry
Western Electric Co.

Battery Charging Apparatus
Cutler-Hammer Mfg. Co.
General Electric Co.
Ward Leonard Elec. Co.
Westinghouse Electric & Mfg. Co.

Bearings
Ball
Standard Steel & Bearings, Inc.
Roller
Standard Steel & Bearings, Inc.

Blowers
American Blower Co.
Sturtevant Co., B. F.

Blowers, Steam Driven
Terry Steam Turbine Co.

Boiler Room Instruments (See Instruments)

Boilers
Water Tube
Babcock & Wilcox Co.

Bond Testers
Roller-Smith Co.

Books, Technical
McGraw-Hill Book Co., Inc.

Boosters
Allis-Chalmers Mfg. Co.
General Electric Co.
Westinghouse Electric & Mfg. Co.

Boxes
Fuse
G & W Elec. Spec. Co.
General Electric Co.
Metropolitan Device Corp.
Schweitzer & Conrad, Inc.
Westinghouse Electric & Mfg. Co.
Junction and Outlet
Chicago Fuse Mfg. Co.
G & W Elec. Spec. Co.
General Electric Co.
Westinghouse Electric & Mfg. Co.
Meter and Service
General Electric Co.
Metropolitan Device Corp.
Westinghouse Elec. Mfg. Co.

Brackets and Pins, Metal
Pittsburgh Transformer Co.

Brushes, Dynamic & Carbon
Jeandron, W. J.
Morganite Brush Co.

Buckets, Clamshell, Excavating and Grab
Hayward Co.

Buildings
Fabricated
Bethlehem Steel Co.
Steel
Delta-Star Elec. Co.
Milliken Bros. Mfg. Co.

Bus Bars
Copper
American Brass Co.

Bus Bar Supports
Delta Star Electric Co.
Electric Power Equip. Corp.
Electrical Development & Mach. Co.
General Electric Co.
Railway & Industrial Eng. Co.
Schweitzer & Conrad, Inc.
Westinghouse Elec. Mfg. Co.

Cable (See Wires & Cables)

Cable Machinery
American Ins. Machy. Co.

Cable Racks, End Bells and Accessories
Elec. Engineers Equip. Co.
G & W Elec. Spec. Co.
Metropolitan Device Corp.
Standard Underground Cable Co.

Cable Splicing Joints
Matthews Corp., W. N.

Car Steps, Safety
Irving Iron Works Co.

Cement.
High Temperature
Johns-Manville, Inc.
Insulator
Reparit Mfg. Co.

Chains
Silent Power Transmission
Morse Chain Co.

Circuit Breakers
Automatic Reclosing Circuit Breaker Co.
Condit Elec'l Mfg. Co.
Cutter Company
General Electric Co
Roller-Smith Co.
Sangamo Electric Co.
Schweitzer & Conrad, Inc.
Sundh Electric Co.
Westinghouse Elec. Mfg. Co.

Clamps
Ground Connection
General Electric Co.
Johnson, Jr., T. F.
Westinghouse Elec. Mfg. Co.
Guy
Matthews Corp., W. N.
Trolley
Ohio Brass Co.

Cleats
Blake Signal & Mfg. Co.
Electrical Development & Mach. Co.
Imperial Porcelain Wks.
Thomas & Sons Co., R.

Clips, Testing
Mueller Electric Co.

Clutches, Magnetic
Cutler-Hammer Mfg. Co.

Coal and Ash Handling Machinery
Combustion Engineering Corp.
Hayward Co.

Coil Winding Tools
Elec. Service Supplies Co.

Coils, Armature, Field and Magnet
Belden Mfg. Co.
Dudlo Mfg. Co.
General Electric Co.

Coils, Choke
Delta Star Elec. Co.
General Electric Co.
Hi-Voltage Equip. Co.
Railway & Industrial Eng. Co.
Schweitzer & Conrad, Inc.
Westinghouse Elec. & Mfg. Co.

Commutators
Cameron Elec. Mfg. Co.

Concrete, Armoring Surface
Irving Iron Works Co.

Condensation Products
Bakelite Corp.
Condensite Co. of Amer.
General Bakelite Co.
Redmanol Chem. Prod. Co.

Condensers
Static
Wireless Spec. App. Co.
Steam
Allis-Chalmers Mfg. Co.
General Electric Co.
Ingersoll-Rand Co.
Nordberg Mfg. Co.
Westinghouse Elec. & Mfg. Co.
Worthington Pump & Mchy. Corp.

Condensers, Rotary Jet
Manistee Iron Works

Conduit Fittings
Chicago Fuse Mfg. Co.

Conduit
Fibre
Johns-Manville, Inc.
Interior
American Circular Loom Company
Johns-Manville, Inc.
Underground
Johns-Manville, Inc.

Connectors
Western Electric Co.
Westinghouse Elec. Mfg. Co.

Connectors and Terminals
Electric Power Equip. Corp.
General Electric Co.
Sherman Mfg. Co., H. B.
Westinghouse Elec. & Mfg. Co.

Construction Engineering (See Directory of Engineers)

Contact Rail Material
Electric Service Supplies Co.
Ohio Brass Co.

Control Signals, Traffic
Essco Mfg. Co.

Controllers
Electric Automatic
Cutler-Hammer Mfg. Co.
Ward Leonard Electric Co.
Motor
General Electric Co.
Sundh Electric Co.
Westinghouse Elec. & Mfg. Co.

Cord
Arc Lamp
Samson Cordage Works
Flexible
Indiana Rubber & Ins. Wire Co.
Okonite Company, The
Trolley
Samson Cordage Co.

Couplings
Flexible
Bartlett Hayward Co.

Crane Motors
General Electric Co.
Westinghouse Elec. & Mfg. Co.

Cranes
Electric
Universal Crane Co.
Locomotive
Universal Crane Co.
Motor Truck
Universal Crane Co.
Portable
Universal Crane Co.
Traveling
Maris Bros.
Northern Eng'g Works

Cross Arms
Railway & Industrial Eng. Co.
Thomas & Sons Co., R.
Western Electric Co.

Cutouts
Chicago Fuse Mfg. Co.
G & W Elec. Spec. Co.
General Electric Co.
Metropolitan Device Corp.
Schweitzer & Conrad, Inc.
Westinghouse Elec. & Mfg. Co.

Doors for Bin and Switch Compartments
Johns-Manville, Inc.

Drills, Rock
Ingersoll-Rand Co.

Economizers
Power Specialty Co.
Sturtevant Co., B. F.

Engineers, Consulting and Contracting
(See Directory of Engineers)

Engines
Diesel
Bethlehem Steel Co.
Lombard Governor Co.
Internal Combustion
McIntosh & Seymour Corp.
Oil
Ingersoll-Rand Co.
Lombard Governor Co.
Nordberg Mfg. Co.
Steam
Allis-Chalmers Mfg. Co.
Ridgway Dynamo & Eng Co.
Sturtevant Co., B. F.
Unaflow
Nordberg Mfg. Co.
Ridgway Dynamo & Eng. Co.

Excavating Machinery, Motor Driven
Hayward Co.

Experimental Apparatus
Biddle, James G.

Fan Motors
Century Electric Co.
Colonial Fan & Motor Co.
Diehl Mfg. Co.
General Electric Co.
Peerless Electric Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

Fans
Exhaust and Ventilating
American Blower Co.
Century Electric Co.
Diehl Mfg. Co.
General Electric Co.
Sturtevant Co., B. F.
Westinghouse Elec. & Mfg. Co.
Turbine Driven
Sturtevant Co., B. F.
Terry Steam Turbine Co.

Fibre (See Insulating Material)

Financial
Harris, Forbes & Co.

Fire Extinguishers
Foamite-Childs Corp.

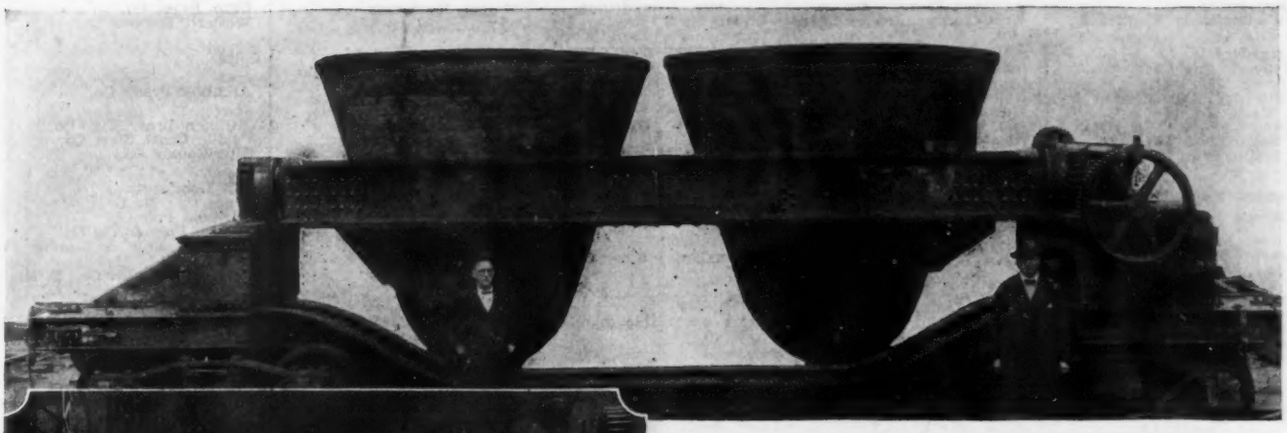
Flooring
Open Steel
Irving Iron Works Co.
Steel, Irving Subway
Irving Iron Works Co.

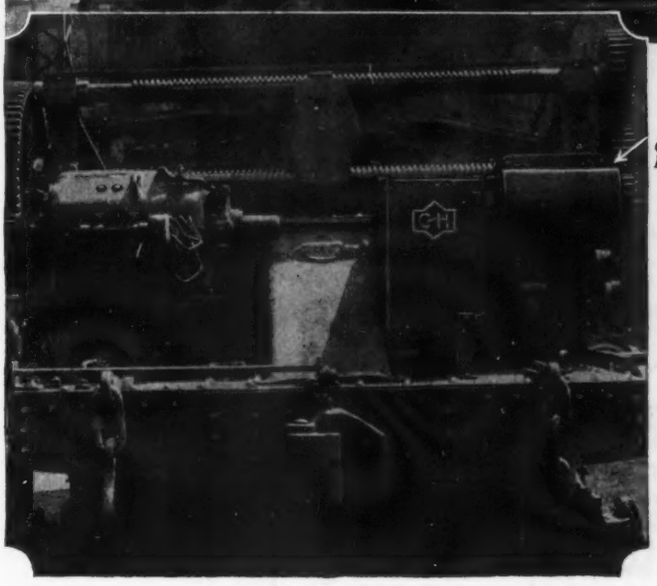
Forgings, Drop, Hammered & Hydraulically Pressed
Bethlehem Steel Co.

Furnaces
Electric
Detroit Electric Furnace Co
Electric Furnace Constr Co.
Pittsburgh Elec. Furnace Corp.
Pulverized Fuel
Combustion Engr. Co.
Steel Melting, Eletric
American Bridge Co.

Fuse Plugs
Delta-Star Electric Co.

Fuses
High Tension
Delta-Star Electric Co.
Elec. Engineers Equip. Co.
Schweitzer & Conrad, Inc.
Refillable
Chicago Fuse Mfg. Co.





New type of electrically tilted cinder car made by the Wm. B. Pollock Co. (Mr. John Morgan, Electrical Engineer) for the Ohio Works of the Carnegie Steel Co. of Youngstown

Cutler-Hammer Limit Switch

New Two-Ladle Cinder Car Equipped with Cutler-Hammer Controller and Limit Switch

Cutler-Hammer Control automatically governs the action of the motor in tilting the pots—the enclosed type Controller accelerating the motor and the Limit Switch interlocked with the Controller, preventing over-travel.

The operator is not called upon to do anything but push the "on" button to start. Yet the functioning of the Controller must be dependable and accurate.

This is but one of thousands of cases where Cutler-Hammer engineers have cooperated with the designer and builder of motor-driven equipment—fitting the Controller to the job to provide the desired results.

During more than a quarter-of-a-century Cutler-Hammer has been developing, building, and applying control equipment. The vast experience and fund of information are at your disposal when you call in a C-H engineer.

CUTLER-HAMMER

Motor Starters, Speed Regulators and Controllers carrying the C-H trade mark are the result of nearly 30 years of experience in the design and manufacture of electric control apparatus.

THE CUTLER-HAMMER MFG. CO.

Motor Control Department

Works: MILWAUKEE *and* NEW YORK

Offices and Agents in Principal Cities

Northern Elec. Co., Ltd., Can.

C-H CUTLER-HAMMER **AUTOMATIC CONTROLLERS**

Renewable
Westinghouse Electric & Mfg. Co.
Standard
Chicago Fuse Mfg. Co.
Condit Elec'l Mfg. Co.
Electrical Development & Mach. Co.
Metropolitan Device Corp.
Western Electric Co.
Westinghouse E. & M. Co.

Gauges, Recording
Bristol Co., The

Gearing, Silent Flexible
Morse Chain Co.

Gears
Bethlehem Steel Co.
General Electric Co.
Westinghouse Elec. & Mfg Co.

Generating Sets, Motor
Burke Electric Co.
General Electric Co.
Ridgway Dynamo & Eng. Co.
Sturtevant Co., B. F.
Westinghouse Elec. & Mfg. Co.

Generators
Burke Elec. Co.
Ridgway Dynamo & Eng. Co.

Generators, Coolers
American Blower Co.
Sturtevant Co., B. F.

Glassware Lighting
Holophane Glass Co.

Grating, Steel Irving Subway
Irving Iron Works Co.

Ground Clamps
Sherman Mfg. Co., H. B.

Grounds, Etc.
Paragon Electric Co.

Hair Dryers
Shelton Elec. Co.

Heaters for Special Purposes
Power Specialty Co.

Heaters, Water Feed
Worthington Pump & Mchy. Corp.

Heating Devices
Cutler-Hammer Mfg. Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

tems
American Blower Co.
Sturtevant Co., B. F.

Hoists
Steam and Electrical
Allis-Chalmers Mfg. Co.

Indicators, Speed (See Tachometers)
Biddle, James G.

Industrial Lighting
Holophane Glass Co.

Inspection and Tests
Electrical Testing Laboratories

Instrument Test Switches
Electrical Development & Mach. Co.

Instrument Transformers
General Electric Co.
Roller-Smith Co.
Westinghouse Elec. & Mfg. Co.

Instruments
Boiler Room
General Electric Co.
Westinghouse Elec. & Mfg. Co.
Graphic
Biddle, James G.
Bristol Co., The
General Electric Co.
Sangamo Electric Co.
Westinghouse Elec. & Mfg. Co.
Zernickow, O.
Indicating
General Electric Co.
Roller-Smith Co.
Westinghouse Elec. & Mfg. Co.
Weston Elec'l Inst. Co.
Integrating
Biddle, James G.
Duncan Elec. Mfg. Co.
Sangamo Electric Co.
Sewickley Elec. Mfg. Co.
Wagner Elec. Corp.
Westinghouse Elec. & Mfg. Co.
Scientific and Testing Service
Biddle, James G.
General Electric Co.
Metropolitan Device Corp.
Roller-Smith Co.
Westinghouse Elec. & Mfg. Co.
Weston Elec'l Inst. Co.

Insulating Machinery
American Ins. Machinery Co.
New England Butt Co.

Insulating Material
Asbestos
Johns-Manville, Inc.
Cement
Condensite Co. of America
Mitchell-Rand Mfg. Co.
Composition Cloth & Paper
Irvington Varnish & Ins. Co.
Compounds, Paints and Varnishes
Garfield Mfg. Co.
General Electric Co.
Irvington Varnish & Ins. Co.
Mitchell-Rand Mfg. Co.
Packard Electric Co.
Redmanol Chem. Prod. Co.
Westinghouse Elec. & Mfg. Co.
Fibre
National Vulc. Fibre Co.
Spaulding Fibre Co.
Laminated Phenolic Condensation Products
Bakelite Corp.
Condensite Co. of Amer.
Continental Fibre Co.
General Bakelite Co.
Redmanol Chem. Prod. Co.
Spaulding Fibre Co.
Westinghouse Elec. & Mfg. Co.
Lava
American Lava Co.
Kirchberger & Co., Inc., M.
Steward Mfg. Co., D. M.
Mica
Munsell & Co., Eugene
Molded
Bakelite Corp.
Condensite Co. of Amer.
Cutler-Hammer Mfg. Co.
Garfield Mfg. Co.
General Bakelite Corp.
Johns-Manville, Inc.
Redmanol Chem. Prod. Co.
Paper
Irvington Varnish & Ins. Co.
Silk
Irvington Varnish & Ins. Co.
Ryle & Co., Wm.
Slate
Portland-Monson Slate Co.
Tape & Webbing
General Electric Co.
Okonite Co., The
Packard Electric Co.
Westinghouse Elec. & Mfg. Co.
Wax Paper
Candy Company, Inc.

Insulation, Electric
Bakelite Corp.
Condensite Co. of Amer.
General Bakelite Co.
Redmanol Chem. Prod. Co.
Spaulding Fibre Co.

Insulator Pins
Ohio Brass Co.
Thomas & Sons Co., R.

Insulator Tester & Fault Finder
Johnson, Jr., T. F.

Insulators
Glass
Hemingray Glass Co.
Lapp Insulator Co., Inc.
Locke Ins. Corp.
Porcelain, Composition
Illinois Elec. Porcelain Co.
Imperial Porcelain Works
Lapp Insulator Co., Inc.
Locke Ins. Corp.
Ohio Brass Co.
Thomas & Sons Co., R.
Westinghouse Elec. & Mfg. Co.
Post Type
Delta Star Electric Co.
Electrical Development & Mach. Co.

Jacks, Pole Pulling and Straightening
Westinghouse Elec. & Mfg. Co.

Laboratories
Electrical Testing Laboratories

Lamp Guards, Inc.
Matthews Corp., W. N.

Lamp Replacers
Matthews Corp., W. N.

Lamps
Arc
General Electric Co.
Westinghouse Elec. & Mfg. Co.
Cable Supporting
Matthews Corp., W. N.
Incandescent
General Electric Co.
Western Electric Co.
Miniature
General Electric Co.

Lights, Traffic
Essco Mfg. Co.

Lightning Arresters
Delta Star Elec. Co.
Electric Power Equip. Corp.
Elec. Service Supplies Co.
Electrical Engineers Equip. Co.
General Electric Co.
Hi-Voltage Equipment Co.
Railway & Indus. Engr. Co.
Schweitzer & Conrad, Inc.
Shaw, Henry M.
Westinghouse Elec. & Mfg. Co.

Line Material
Anderson Mfg. Co., A. & J. M.
Archbold-Brady Co.
Bethlehem Steel Co.
G & W Elec. Spec. Co.
Electric Service Sup. Co.
General Electric Co.
Johnson, Jr., T. F.
Ohio Brass Co.
Westinghouse Elec. & Mfg. Co.

Linemen's Supplies & Tools
Johnson, Jr., T. F.

Lubricants
Waverly Oil Co.

Lugs
Sherman Mfg. Co., H. B.

Machines
Armature Notching
Ferracute Machine Co.
Pipe Bending
American Pipe Bend. Mach. Co.

Machinery, Hoisting
American Bridge Co.

Magnets
Dudlo Mfg. Co.
Elec. Controller & Mfg. Co.

Manganin
Baker & Co., Inc.

Meter Testers
General Electric Co.
Westinghouse Elec. & Mfg. Co.

Meters, Electric & Flow (See Instruments, Electric & Boiler Room)

Mining Machinery
Allis-Chalmers Mfg. Co.

Molded Insulation (See Insulation, Molded)

Molding Materials
Bakelite Corp.
Condensite Co. of Amer.
General Bakelite Co.
Redmanol Chem. Prod. Co.

Motor Generator Sets
Ridgway Dynamo & Eng. Co.

Motors
Allis-Chalmers Mfg. Co.
Baldor Electric Co.
Burke Elec. Co.
Century Electric Co.
Colonial Fan & Motor Co.
Diehl Mfg. Co.
Electro-Dynamic Co.
Emerson Electric Mfg. Co.
General Electric Co.
Gregory Electric Co.
Imperial Elec. Co
Jeannin Electric Co.
Master Electric Co.
Peerless Electric Co.
Reliance Elec. & Eng. Co.
Star Elec. Motor Co.
Sturtevant Co., B. F.
Triumph Electric Co.
Wagner Elec. Corp.
Westinghouse Elec. & Mfg.
Zobell Elec. Motors Co.
Small
Reynolds Electric Co.

Oil Engines (See Engines)

Oil Heaters
Power Spec. Co.

Oil Pressure Governors
Lombard Governor Co.

Oil and Grease, Lubricating
Waverly Oil Co.

Packing
General Electric Co.
Westinghouse Elec. & Mfg. Co.
Asbestos
Johns-Manville, Inc.

Panel Boards
General Electric Co.
Johns-Manville, Inc.
Westinghouse Elec. & Mfg. Co.

Panels, Switchboard
Allis-Chalmers Mfg. Co.
General Elec. Co.
Westinghouse Elec. & Mfg. Co.

Pavement Breakers, Pneumatic
Ingersoll-Rand Co.

Penstocks
Pelton Water Wheel Co.

Pipe Frame Fittings, Electrical
Schweitzer & Conrad, Inc.

Pipe
Riveted Steel
Riter-Conley Co.

Platinum
Baker & Co., Inc.

Plugs
Cutler-Hammer Mfg. Co.

Plugs, Attachment
Cutler-Hammer Mfg. Co.
General Elec. Co.
Westinghouse Elec. & Mfg. Co.

Pole Line Hardware
Bethlehem Steel Co.
Electric Service Sup. Co.
Ohio Brass Co.
Western Electric Co.

Poles
Iron
Archbold-Brady Co.
Steel
Milliken Bros. Mfg. Co.
Pacific Coast Steel Co.
Riter-Conley Co.
Wood
Bell Lumber Co.
Bruce Co., M. L.
National Pole Co.
Naugle Pole & Tie Co.
Northern Pole & Lumber Co.
Partridge Lumber Co., T. M.
Seguin, J. J.
Texas Creosoting Co.
Western Electric Co.

Porcelain (See Insulating Material, China and Porcelain

Posts, Wood
Naugle Pole & Tie Co.

Potentiometers
Biddle, James G.
Westinghouse Elec. & Mfg Co.

Potheads
Electrical Development & Mach. Co.
G & W Elec. Spec. Co.

Presses, Cutting
Ferracute Machine Co.

Projectors, Floodlights
Electric Service Supplies Co.

Protective Devices
Electric Power Equip. Corp.
General Electric Co.
Metropolitan Device Corp.
Railway & Industrial Eng. Co.
Roller-Smith Co.
Schweitzer & Conrad, Inc.
Westinghouse Elec. & Mfg. Co.

Pullers, Slack
Matthews Corp., W. N.

Pulverized Fuel Equipment
Combustion Engineering Corp.

Pumping Systems, Air Lift
Ingersoll-Rand Co.

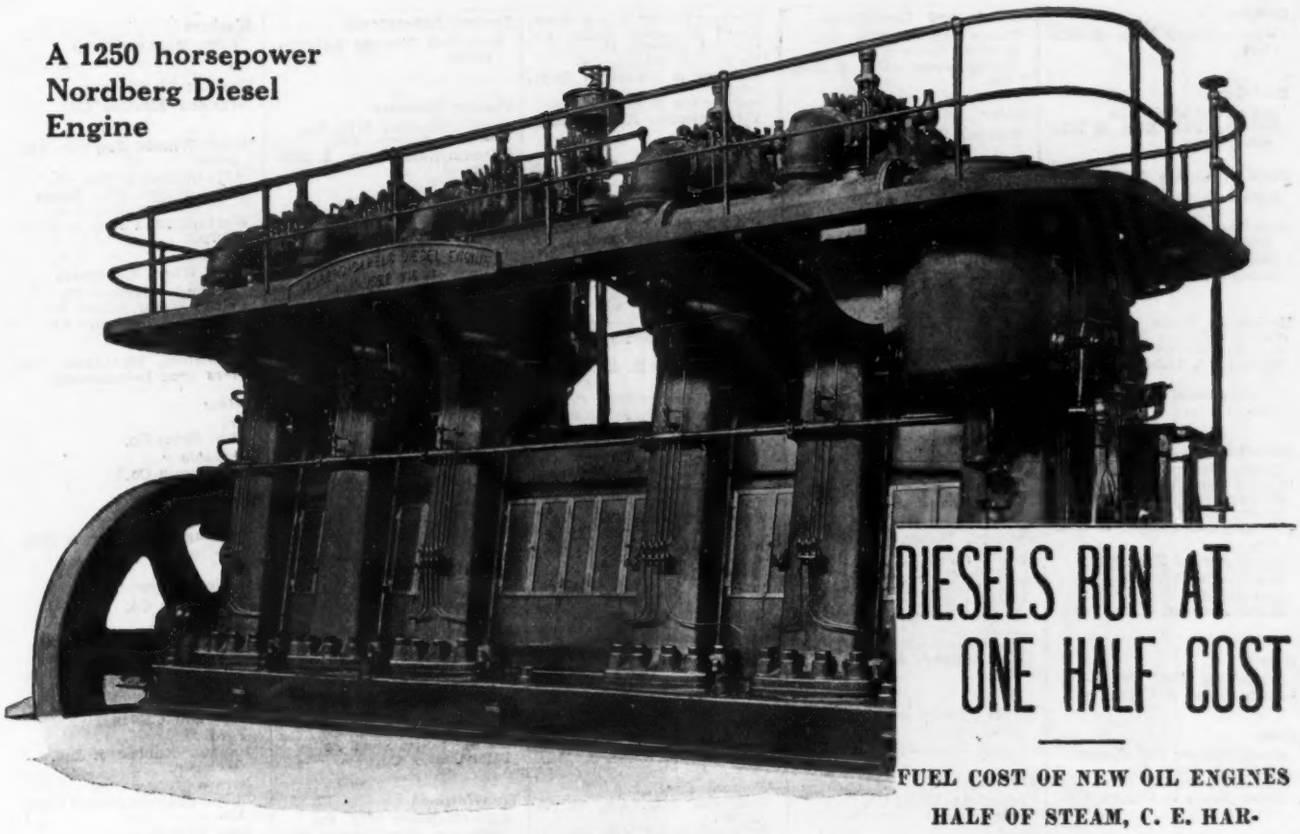
Pumps
Boiler Feed
Ingersoll-Rand Co.
Lecourtenay Co.
Worthington Pump & Mchy. Corp.
Centrifugal
Allis-Chalmers Mfg. Co.
Chicago Pump Co.
De Laval Steam Turbine Co.
Ingersoll-Rand Co.
Lecourtenay Co.
Manistee Iron Works
Pelton Water Wheel Co.
Terry Steam Turbine Co.
Worthington Pump & Mchy. Corp.
Power
Lecourtenay Co.
Worthington Pump & Mchy. Corp.
Reciprocating
Allis-Chalmers Mfg. Co.
Terry Steam Turbine Co.
Steam
Worthington Pump & Mchy. Corp.

Pyrometers
Bristol Co., The
Taylor Instrument Co.

Radio Apparatus
Cutler-Hammer Mfg. Co.
General Electric Co.
General Radio Co.
Roller-Smith Co.
Westinghouse Elec. & Mfg. Co.

Rail Bonds
American Steel & Wire Co.
Ohio Brass Co.

A 1250 horsepower Nordberg Diesel Engine



DIESELS RUN AT ONE HALF COST

FUEL COST OF NEW OIL ENGINES HALF OF STEAM, C. E. HARGER ESTIMATES

The fuel cost is cut to one half by the use of Diesel oil engines in generating electric power, C. E. Harger, general manager of the Peninsular Power Co., said yesterday in commenting on the saving and practicability of oil over steam. At least that is his present calculation, with the first of the Diesel engines at the new power plant of the company in operation only since February 1.

"Go anywhere east of the Mississippi, even of New Mexico and you'll find we have the largest Diesel engines now in use," he said. The engines are huge mountains of steel, their very size breathing tremendous power, but there is not much noise to the throbbing machine. It runs on and on at an even pace like a finely tuned motor in an automobile.

The consumption figure startles at first—it is 1,850 gallons of crude oil every 24 hours—but translated into dollars the amount is one half of producing an equal amount of power by steam. The figures are set down in the books side by side, for the Peninsular Power Co., at its Iron River station is now developing electric power by both processes—and the new method has it on the old by a mile.

1250 H. P. Each.

Twelve hundred and fifty horsepower or 800

Fuel Cost Reduced 50% In a Large Central Station

Fuel is the largest item of expense in the operation of power plants, particularly so in central stations. All engineering skill is centered on the problem of improving the efficiency of generating stations largely by reducing the fuel expense.

The Peninsular Power Company, Iron River, Michigan, serving municipalities and iron mines throughout the Menominee range, has solved the problem by the installation of two 1250 H.P. Nordberg Two-Cycle Diesel engines. These units have reduced the cost of fuel 50% in comparison with power as produced by steam turbines.

This company operates four hydro-electric stations and annually produces over 58,000,000 K.W. hours. During the periods of low water, stand-by service has been supplied by steam plants, but after careful investigation it has been proved that this service can be furnished at a lower cost with large Diesel units.

The newspaper clipping taken from the Iron River Reporter tells the story. This is only one application where Nordberg Diesels have shown marked savings and increased profits.

Nordberg Engineers will, without obligation, acquaint you with the possibility of Diesel power. *Write for Bulletin LD-3.*

Nordberg Manufacturing Company

Milwaukee

Diesel Engines
Compressors
Blowing Engines
Mine Hoists

NORDBERG MACHINERY

Uniflow Engines
Condensers
Corliss Engines
Special Machinery

Ranges
Westinghouse Elec. & Mfg Co.

Rectifiers
General Electric Co.
Westinghouse Elec. & Mfg Co.

Reels, Take Up & Pay Out
Matthews Corp., W. N.

Repairing (See Searchlight Section)
Bonstead Elec. & Mfg. Co.
Commonwealth Edison Co

Resistance Units
Cutler-Hammer Mfg. Co.
General Electric Co.
Railway & Industrial Eng. Co.
Westinghouse Elec. & Mfg Co.

Rheostats
Biddle, James G.
Cutler-Hammer Mfg. Co.
General Electric Co.
Sundh Electric Co.
Westinghouse Elec. & Mfg. Co.
Motor Speeed Regulating
Ward Leonard Elec. Co.
Starting and Controlling
Ward Leonard Elec. Co.

Rivets
Bethlehem Steel Co.
Rome Brass & Copper Co.

Rods
Brass, Copper and Bronze
American Brass Co.
American Copper Prod. Co.
Rome Brass & Copper Co.

Rolls
Brass, Copper and Bronze
Rome Brass & Copper Co.

Searchlights
General Electric Co
Westinghouse Elec. & Mfg. Co.

Second-Hand Apparatus (See Searchlight Section)
Albertson Co., Inc., W. N.
Archer & Baldwin
Ashley, Allen
Brenholts, Roy, Trustee
Ellis, A. Lee
Emerson & Co., Louis E.
Fuerst-Friedman Co.
Gregory Electric Co.
Hall & Co., Inc., Stephen
Hemphill & Co., J. L.
Ives Mfg. Co.
Klein & Co., Nathan
Land, L. J.
McMillan, A.
Miami Conservancy Dist.
Miller-Owen Electric Co.
Moore & MacDonald
Morrison Co., Hackley
Nussbaum Co., V. M.
Phoenix Utility Co.
Power Machy. Ex.
Randle Machy. Co.
Ross Power Equip. Co.
Roswell, C. M.
Sachsenmaier Co., George
Scheinert Co., R.
Wallace Co., J. V.
Wilson Machy. Co., H. R.
Zelnicker, in St. Louis

Shades & Reflectors
Holophane Glass Co.

Sheets
Brass, Copper and Bronze
American Brass Co.
Rome Brass & Copper Co.
Electrical
American Sheet & Tin Plate Co.
Mansfield Sheet & Tin Plate Co.
Newport Rolling Mill Co.
Wheeling Steel Products Co.
Metal
American Sheet & Tin Plate Co.
Bethlehem Steel Co.

Silent Chain Drives
Morse Chain Co.

Slate
Portland-Monson Slate Co.

Sockets and Receptacles
Cutler-Hammer Mfg. Co.
General Electric Co.
Westinghouse Elec. & Mfg. Co.

Solder
Mitchell-Rand Mfg. Co.

Soldering Flux
Blake Signal & Mfg. Co.
Mitchell-Rand Mfg. Co.

Solenoids (See Coils, Armatures, Field and Magnet)

Springs
American Steel & Wire Co.

Sprockets, Silent Chain
Morse Chain Co.

Stair Steps, Safety
Irving Iron Works Co.

Staples
American Steel & Wire Co.
Blake Signal & Mfg. Co.

Starters, Motor, Electric
Automatic Reclosing Circuit Breaker Co.
Condit Elec'l Mfg. Co.
Cutler-Hammer Mfg. Co.
General Electric Co.
Sundh Electric Co.
Ward Leonard Elec. Co.
Westinghouse Elec. & Mfg. Co.

Steam Specialties
Johns-Manville, Inc.
Power Specialty Co.

Stokers
American Engr. Co.
Babcock & Wilcox Co.
Combustion Engr. Corp.
General Electric Co.
Riley Stoker Co., Sanford
Westinghouse Elec. & Mfg. Co.
Mechanical
American Engr. Co.
Combustion Engr. Corp.

Stoves (See Ranges)

Strips, Copper
American Copper Prod. Co.

Structural Steel
Bethlehem Steel Co.
Milliken Bros. Mfg. Co.
Pacific Coast Steel Co.

Sub-Stations, Outdoor
Delta Star Elec. Co.
Electric Power Equip. Corp.
Elec'l Engineers Equip. Co.
General Electric Co.
Railway & Industrial Eng. Co.
Schweitzer & Conrad, Inc.
Westinghouse Elec. & Mfg. Co.

Superheaters, Steam
Babcock & Wilcox Co.
Power Specialty Co.
Superheater Co.

Supplies (Electric Railway)
General Electric Co.
Ohio Brass Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

Switchboard Supplies
Electric Power Equip. Corp.
General Electric Co.
Westinghouse Elec. & Mfg. Co.

Switchboards
Allis-Chalmers Mfg. Co.
Anderson Mfg. Co., A. & J. M.
Condit Elec'l Mfg. Co.
General Electric Co.
Johns-Manville, Inc.
Wagner Elec. Corp.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

Switches
Air Break and Pole Top
Condit Elec'l Mfg. Co.
Delta-Star Elec. Co.
Electric Power Equip. Corp.
Elec'l Engineers Equip. Co.
General Electric Co.
Hi-Voltage Equip. Co.
Railway & Industrial Engr. Co.
Schweitzer & Conrad, Inc.
Westinghouse Elec. & Mfg. Co.
Disconnecting
Anderson Mfg. Co., A. & J. M.
Champion Switch Co.
Delta Star Elec. Co.
Electric Power Equip. Corp.
Elec'l Engineers Equip. Co.
Electrical Development & Mach. Co.
General Electric Co.
Johnson, Jr., T. F.
Matthews Corp., W. N.
Schweitzer & Conrad, Inc.
Trumbull Electric Mfg. Co.
Co.
Westinghouse E. & M. Co.
Float
Cutler-Hammer Mfg. Co.
Electric Service Supplies Co.
General Electric Co.
Ohio Brass Co.
Sundh Electric Co.
Western Electric Co.
Westinghouse Elec. & Mfg.
Fuse
General Electric Co.
Matthews Corp., W. N.
Metropolitan Device Corp.
Schweitzer & Conrad, Inc.
Westinghouse Elec. & Mfg. Co.
Knife
Condit Elec'l Mfg. Co.
Cutter Company
General Electric Co.
Trumbull Elec. Mfg. Co.
Westinghouse Elec. & Mfg. Co.
Oil
Condit Elec'l Mfg. Co.
General Electric Co.
Westinghouse Elec. & Mfg. Co.
Remote Control
Anderson Mfg. Co., A. & J. M.
Cutler-Hammer Mfg. Co.
General Electric Co.
Payne Dean, Ltd.
Sundh Electric Co.
Westinghouse Elec. & Mfg. Co.
Safety Enclosed
General Electric Co.
Trumbull Elec. Mfg. Co.
Westinghouse Elec. & Mfg. Co.
Series
Cutler-Hammer Mfg. Co.
General Electric Co.
Westinghouse Elec. & Mfg. Co.
Snap and Push Button
Cutler-Hammer Mfg. Co.
G & W Elec. Spec. Co.
General Electric Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.
Time
Anderson Mfg. Co., A. & J. M.
General Electric Co.
Paragon Electric Co.
Westinghouse Elec. & Mfg. Co.

Synchroscopes
Roller-Smith Co.
General Electric Co.
Schweitzer & Conrad, Inc.
Westinghouse Elec. & Mfg. Co.
Weston Elec'l Inst. Co.

Tachometers
Biddle, James G.
Bristol Co., The
Zernickow, O.

Tanks
Riter-Conley Co.

Tape
Friction
Johns-Manville, Inc.
Rubber
Johns-Manville, Inc.

Telephones
Western Electric Co.

Testing Apparatus
American Transformer Co.
Biddle, James G.
General Electric Co.
Roller-Smith Co.
Westinghouse Elec. & Mfg. Co.

Testing Laboratories
Electrical Testing Laboratories

Theatre Dimmers
Cutler-Hammer Mfg. Co.
General Electric Co.
Westinghouse Elec. & Mfg. Co.

Thermometers
Bristol Co., The

Ties
Naugle Pole & Tie Co.

Toaster
Westinghouse Elec. & Mfg. Co.

Tools
Construction
Leach Co.
Pneumatic
Ingersoll-Rand Co.
Portable Elec.
Leffel & Sons Co., James

Tools, Linemen's (See Linemen's Supplies & Tools)

Towers
Radio
Milliken Bros. Mfg. Co.
Pacific Coast Steel Co.
Riter-Conley Co.
Transmission
American Bridge Co.
Archbold-Brady Co.
Milliken Bros. Mfg. Co.
Pacific Coast Steel Co.
Riter-Conley Co.

Transformers
Allis-Chalmers Mfg. Co.
American Transformer Co.
General Electric Co.
Kuhlman Electric Co.
Moloney Elec. Co.
Packard Electric Co.
Pittsburgh Transformer Co.
Wagner Elec. Corp.
Westinghouse Elec. & Mfg. Co.
Instrument
Roller-Smith Co.
Weston Elec'l Inst. Co.

Transformers, Bell Ringing
General Electric Co.
Metropolitan Device Corp.
Packard Electric Co.
Westinghouse Elec. & Mfg. Co.

Transmission, Silent Chain
Morse Chain Co.

Traps, Steam
Johns-Manville, Inc.

Tubes
Brass, Copper and Bronze
American Brass Co.
Rome Brass & Copper Co.

Turbines
Hydraulic
Allis-Chalmers Mfg. Co.
Leffel & Co., James
Pelton Water Wheel Co.
Smith Co., S. Morgan
Worthington Pump & Mchy. Corp.
Steam
Allis-Chalmers Mfg. Co.
De Laval Steam Turbine Co.
General Electric Co.
Ridgway Dynamo & Eng. Co.
Sturtevant Co., B. F.
Terry Steam Turbine Co.
Westinghouse Elec. & Mfg. Co.

Turbo-Generators
General Electric Co.
Terry Steam Turbine Co.
Westinghouse Elec. & Mfg. Co.

Units, Resistor
Ward Leonard Elec. Co.

Vibrators
Shelton Elec. Co.

Washers
Mass. Machine Shop

Washing Machines
Western Electric Co.

Water Wheels, Impulse Turbines
Allis-Chalmers Mfg. Co.
Leffel & Sons Co., James
Pelton Water Wheel Co.
Worthington Pump & Mchy. Corp.

Water Wheel Governors
Lombard Governor Co.
Pelton Water Wheel Co.
Woodward Governor Co.

Wattmeters, Watt-Hour Meters (See Instruments)

Welder
Arc
Ohio Brass Co.
Portable
Ohio Brass Co.

Welders, Arc
General Electric Co.
Westinghouse Elec. & Mfg. Co.

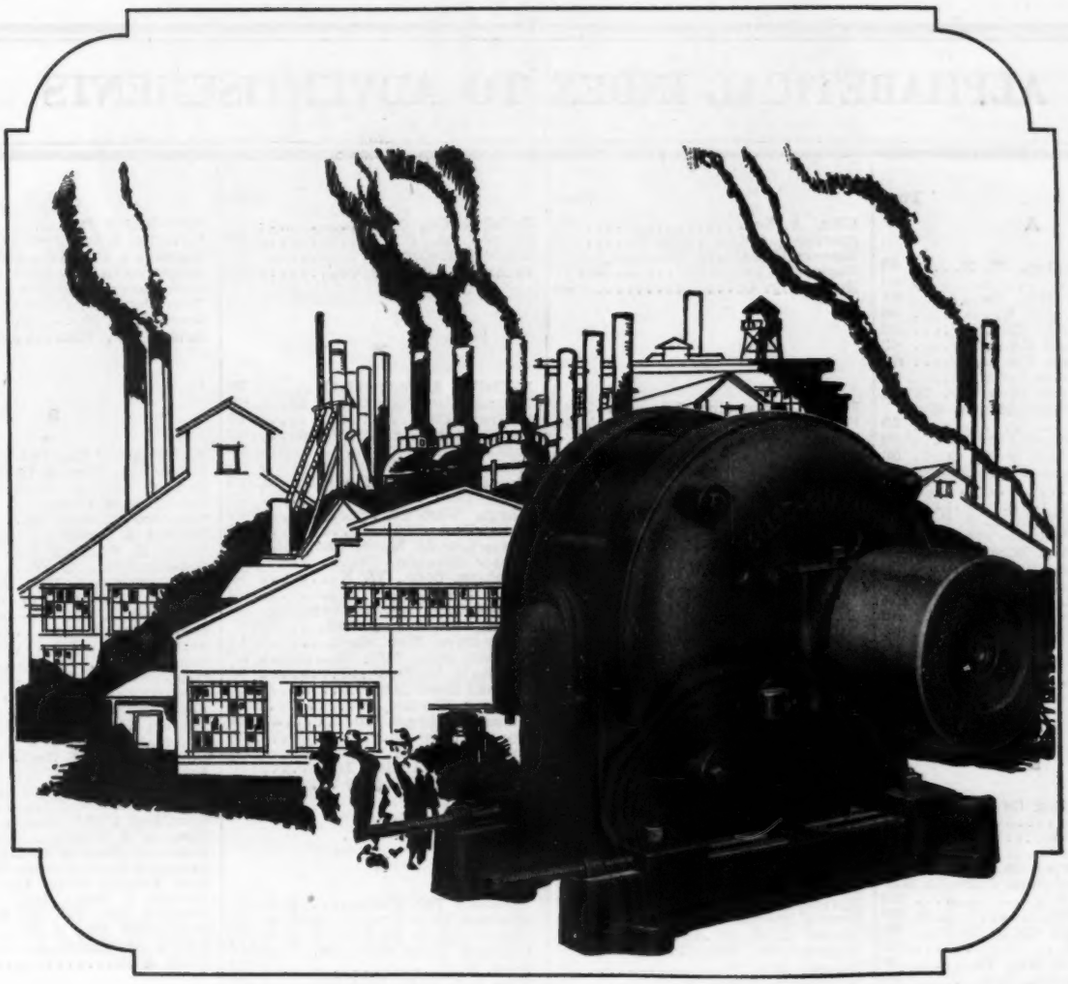
Welding Apparatus
Ohio Brass Co.

Welding Machines
General Electric Co.
Westinghouse Elec. & Mfg. Co.

Wires and Cables
Auto
Indiana Rubber & Ins. Wire Co.
Bare and Insulated
Standard Underground Cable Co.
Bare Copper
American Brass Co.
American Copper Prod. Co.
American Ins. Wire & Cable Co.
American Steel & Wire Co.
Anaconda Copper Mining Co.
Illinois Wire & Cable Co.
Brass & Bronze
American Copper Prod. Co.
Copper Clad
American Copper Prod. Co.
Magnet
American Enameled Magnet Wire Co.
Belden Mfg. Co.
Dudlo Mfg. Co.
Hazard Mfg. Co.
Maring Wire Co.
Roebling Sons Co., J. A.
Western Electric Co.
Magnet (Enameled)
Dudlo Mfg. Co.
Maring Wire Co.
Miscellaneous
Belden Mfg. Co.
Rubber Covered and Weatherproof
American Copper Prod. Co.
American Ins. Wire & Cable
Belden Mfg. Co.
Hazard Mfg. Co.
Illinois Wire & Cable Co.
Indiana Rub. & Ins. Wire Co.
Kerite Ins. Wire & Cable Co.
Okonite Co., The
Packard Electric Co.
Roebling's Sons Co., J. A.
Safety Ins. Wire & Cable Co.
Simplex Wire & Cable Co.
Western Electric Co.
Steel
American Steel & Wire Co.
Bethlehem Steel Co.
Trolley
American Copper Prod. Co.
Underground (Cable)
Hazard Mfg. Co.
Kerite Ins. Wire & Cable Co.
Roebling Sons Co., J. A.
Western Electric Co.
Varnished Cambric
Okonite Co., The

Wireless Apparatus
General Electric Co.
Westinghouse Elec. & Mfg Co.

X-Ray Apparatus
Anderson Mfg. Co., A. & J. M.



The Type "AR" Has a Broad Range of Industrial Usefulness

Allis-Chalmers Type "AR" Motors are of special interest to Plant Executives and Maintenance Men because of their all-steel construction, and the simplicity which results from unit features of design. For example, the stator end frames and feet are cast as a unit from electric steel. This insures great rigidity and eliminates breakage.

Intelligently selected for specific needs the "AR" has tremendous adaptability. It is capable of handling the stiffest assignment without faltering day in and day out for long periods. It is built for hard service and trying conditions and it does the job wherever put. Built in sizes from $\frac{3}{4}$ H. P. to 200 H. P. for all the standard voltages.

Send for Bulletin No. 118C

ALLIS-CHALMERS PRODUCTS
Electrical Machinery
Steam Turbines
Steam Engines
Gas and Oil Engines
Hydraulic Turbines
Crushing and Cement Machinery
Mining Machinery

ALLIS-CHALMERS MANUFACTURING COMPANY
MILWAUKEE, WISCONSIN, U.S.A.
District Offices in All Leading Cities

ALLIS-CHALMERS PRODUCTS
Flour and Saw Mill Machinery
Power Transmission Machinery
Pumping Engines-Centrifugal Pumps
Steam and Electric Hoists
Air Compressors - Air Brakes
Agricultural Machinery
Condensers

ALPHABETICAL INDEX TO ADVERTISEMENTS

Page

A

Albertson Co., Inc., W. N. 46
Allen-Ashley 45
Allis-Chalmers Mfg. Co. 81
Allison & Co., Jas. E. 36
Ambursen Constr. Co. 36
American Blower Co. 62
American Bridge Co. 57
American Circular Loom Co. 49
American Copper Prod. Co. 20, 21
American Enameled Magnet Wire Co. 49
American Engineering Co. 60
American Insulatg. Mchy. Co. 50
American Insulated Wire & Cable Co. 49
American Lava Corp. 48
American Pipe Bend Mach. Co. 64
American Sheet & Tin Plate Co. 51
American Steel & Wire Co. 49
American Transformer Co. 56
Anaconda Copper Mining Co. 51
Anderson Mfg. Co., A. & J. M. 58
Archbold-Brady Co. 53
Archer & Baldwin, Inc. 43
Arnold Co. 36
Automatic Reclosing Circuit Breaker Co. 70

B

Babcock & Wilcox Co. 62
Bakelite Corp. 48
Baker & Co., Inc. 51
Baldor Electric Co. 71
Bartlett Hayward Co. 68
Bates Expanded Steel Truss Co., B.C.
Belden Mfg. Co. 50
Bell Lumber Co. 52
Bethlehem Steel Co. 67
Biddle, Jas. G. 55
Blake Signal & Mfg. Co. 49
Brenholts, Trustee, Roy 46
Bristol Co., The 60
Bruce Co., M. L. 52
Burke Electric Co. 72
Byllesby 36

C

Cameron Elec. Mfg. Co. 71
Candy & Company, Inc. 51
Century Electric Co. 72
Champion Switch Co. 9
Cheney, Edw. J. 36
Chicago Fuse Mfg. Co. 59
Chicago Pump Co. 60
Colonial Fan & Motor Co. 72
Combustion Engr. Corp. 61
Condensite Co. of America 48
Condit Elec'l Mfg. Co. 57
Cooper & Co., Hugh L. 36
Cutler-Hammer Mfg. Co. 77
Cutter Company 55

D

Day & Zimmermann, Inc. 36
De Laval Steam Turbine Co. 63
Delta-Star Electric Co. 6
Detroit Elec. Furnace Co. 60
Diehl Mfg. Co. 73
Directory of Engineers 36, 37
Dudlo Mfg. Co. 23
Duncan Elec. Mfg. Co. 19

E

Electric Bond & Share Co. 59
Electric Furnace Constr. Co. 60
Electric Power Equip. Corp. 53
Electric Service Supplies Co. 68
Electrical Development & Mach. Co. 52
Electrical Engineers Equip. Co. 8
Electrical Testing Lab. 36
Electrical World 3
Electro Dynamic Co. 71

Page

Ellis, A. Lee 45
Emerman & Co., Louis E. 45
Emerson Elec. Mfg. Co. 72
Engineers' Directory 36, 37
Esco Mfg. Co. 59

F

Fargo Engineering Co. 36
Ferracute Mach. Co. 66
Foamite-Childs Corp. 4
Ford, Bacon & Davis 36
Fowle, Frank F. 36
Freeman, Roger M. 36
Fuerst-Friedman Co. 44

G

G. & W. Elec. Spec. Co. 57
Gannett, Seelye & Fleming, Inc. 36
Garfield Mfg. Co. 50
General Bakelite Co. 48
General Electric Co., 29, 30, 31, 32, 33, 63
General Porcelain Co. 54
General Radio Co. 58
Gregory Electric Co. 40

H

Hackley Morrison Co. 46
Hall & Co., Stephen 41
Harper & Taylor 36
Harris, Forbes & Co. 35
Harza, L. F. 36
Hayward Co., The 66
Hazard Mfg. Co. 50
Hemingray Glass Co. 54
Hemphill & Co., Inc., J. L. 41
Hi-Voltage Equipment Co. 53
Holophane Glass Co. 18
Hoosier Engr. Co. 36

I

Illinois Wire & Cable Co. 50
Imperial Electric Co. 70
Imperial Porcelain Works 50
Indiana Rub. & Ins. Wire Co., 3rd Cover
Ingersoll-Rand Co. 5
Irving Iron Works Co. 66
Irvington Varnish & Ins. Co. 50
Ives & Davidson 36
Ives Mfg. Co. 44

J

Jeandron, W. J. 70
Jeannin Electric Co. 71
Johns-Manville, Inc. 26, 27
Johnson, Jr., T. F. 7

K

Kansas City Power & Light Co. 42
Kerite Ins. Wire & Cable Co. 34
Kirchberger & Co., Inc., M. 48
Klein & Co., Nathan 46
Krehbiel Co. 36
Kuhlman Electric Co. 57

L

Land, L. J. 44, 46
Lapp Insulator Co., Inc. 54
Leach Company 52
LeCarbone Co. 70
Lecourtenay Co. 60
Lee, Wm. S. 36

Page

Leffel & Co., James 62
Lincoln Co., E. S. 36
Locke Ins. Corp. 11
Lombard Governor Co. 64

M

McClellan & Junkersfeld 36
McGraw Hill Book Co. 54, 58, 68
McGraw Co. 44
McIntosh & Seymour Corp. 69
McMillan, A. 47
Manistee Iron Works Co. 60
Mansfield Sheet & Tin Plate Co. 48
Marble-Card Electric Co. 72
Maring Wire Co. 49
Maris Bros. 66
Massachusetts Mach. Shop, Inc. 70
Master Electric Co. 73
Matthews Corp., W. N. 53
Mead, Daniel W. 36
Metropolitan Device Corp. 2
Miami Conservancy Dist. 46, 47
Miller-Owen Elec. Co. 43
Milliken Bros. Mfg. Co. 53
Mincho & Phillips 36
Mitchell-Rand Mfg. Co. 22
Moloney Electric Co. ..... F. C.
Morganite Brush Co. 71
Morse Chain Co. 73
Mueller Electric Co. 59
Mullergren, Arthur L. 36
Munsell & Co., Eugene 51

N

Nashville Ind. Corp. 46, 47
National Pole Co. 12
Naugle Pole & Tie Co. 52
National Vulc. Fibre Co. 48
Neall, N. J. 36
New Pittsburgh Coal Co. 46
Newport Rolling Mill Co. 48
Nordberg Mfg. Co. 79
Northern Engineering Works 66
Northern Industrial Chemical Co. 48
Northern Pole & Lumber Co. 52
Nussbaum & Co., V. M. 44

O

Ohio Brass Co. 57
Oklahoma High Line Constr. Co. 36
Okonite Co., The 48
Olean, Bradford Co. & Salamanca Ry. 47
Ophuls & Hill, Inc. 36

P

Pacific Coast Steel Co. 53
Packard Electric Co. 56
Paragon Electric Co. 56
Parsons, Klapp, Brinckerhoff & Douglas 37
Partridge Lumber Co., T. M. 52
Payne Dean, Ltd. 62
Peerless Electric Co. 73
Pelton Water Wheel Co. 63
Phoenix Utility Co. 47
Pittsburgh Elec. Furnace Corp. 60
Pittsburgh Transformer Co. 56
Portland-Monson Slate Co. 58
Power Machinery Ex. 42, 47
Power Specialty Co. 65
Public Service Prod. Co. 37

R

Railway & Industrial Eng. Co. 54
Randle Machy. Co. 47
Redmanol Chem. Prod. Co. 48
Reed, W. Edgar 37
Reliance Elec. & Engrg. Co. 72
Reparit Mfg. Co. 50
Reynolds Elec. Co. 72
Ridgeway Dynamo & Eng. Co. 64
Riley Stoker Co., Sanford 62

Page

Riter-Conley Co. 53
Robinson & Co., Dwight P. 37
Roebling's Sons Co., John A. 50
Roller-Smith Co. 55
Rome Brass & Copper Co. 71
Ross Power Equipment Co. 46
Roswell, C. M. 47
Ryle & Co., Wm. 50

S

Sachsenmaier Co., George 45
Safety Ins. Wire & Cable Co. 50
Samson Cordage Works 49
Sanderson & Porter 37
Sangamo Electric Co. 25
Sargent & Lundy 37
Sayer, E. Y. Eng'g Corp. 37
Scheidenhelm, F. W. 36
Schweitzer & Conrad, Inc. 10
Scofield Engr. Co. 37
Scovill Mfg. Co. 64
Searchlight Section 38, 47
Seguin, J. J. 52
Scheinert Co., R. 43
Sessions Engr. Co. 37
Sewickley Electric Mfg. Co. 58
Shaw, Henry M. 54
Shelton Electric Co. 70
Sherman Mfg. Co., H. B. 56
Simplex Wire & Cable Co. 24
Smith, Edw. P. 37
Smith Co., S. Morgan 63
Snook-Hillhouse Co. 37
Spaulding Fibre Co. 51
Spooner & Merrill 37
Standard Steel & Bearings, Inc. 73
Standard Underground Cable Co. 49
Star Electric Motor Co. 70
Stevens & Wood, Inc. 37
Steward Mfg. Co., D. M. 48
Sturtevant Co., B. F. 71
Sundh Electric Co. 55
Swift & Co. 46

T

Taylor Instrument Co. 66
Terry Steam Turbine Co. 63
Texas Creosoting Co. 52
Thebo, Starr & Anderton, Inc. 37
Thomas & Sons Co., R. 56
Thomas, Percy H. 37
Torrence, J. F. 46, 47
Traylor Engr. & Mfg. Co. 47
Triumph Electric Co. 73
Trumbull Elec. Mfg. Co. 58

U

U. S. Food Prod. Corp. (Ill.) 46
Universal Crane Co. 56

W

Wagner Elec. Corp. 74-75
Wallace Co., Inc., J. V. 44
Ward Leonard Electric Co. 58
Waverly Oil Works Co. 64
Western Electric Co. 13
Westinghouse Elec. & Mfg. Co., 14, 15, 16, 17
Weston Elec'l Inst. Co. 28
Wheeling Steel Corporation 48
White Engr. Corp., J. G. 37
Wickes Boiler Co. 62
Williams, Gardner S. 37
Wireless Spec. Apparatus Co. 59
Wood & Weber 37
Woodward Governor Co. 64
Worthington Pump & Machy. Corp. 63

Z

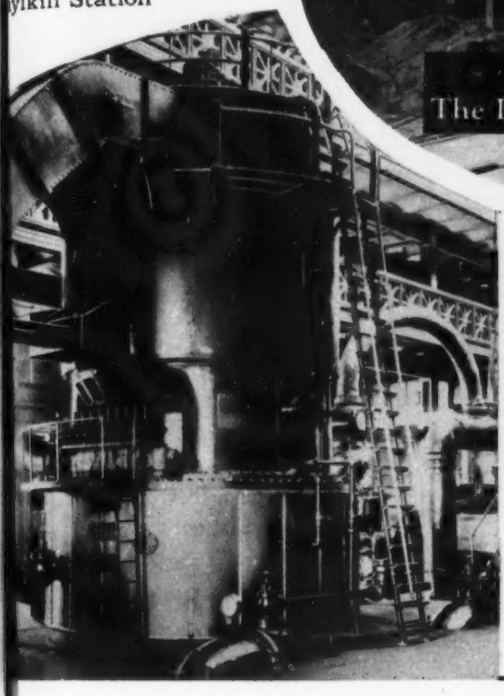
Zelnicker in St. Louis 46
Zernickow, O. 70
Zobel Elec. Motors Co. 70

1911

0-kw., 6000-volt
ine Generator—one
e five verticals in
ylkill Station

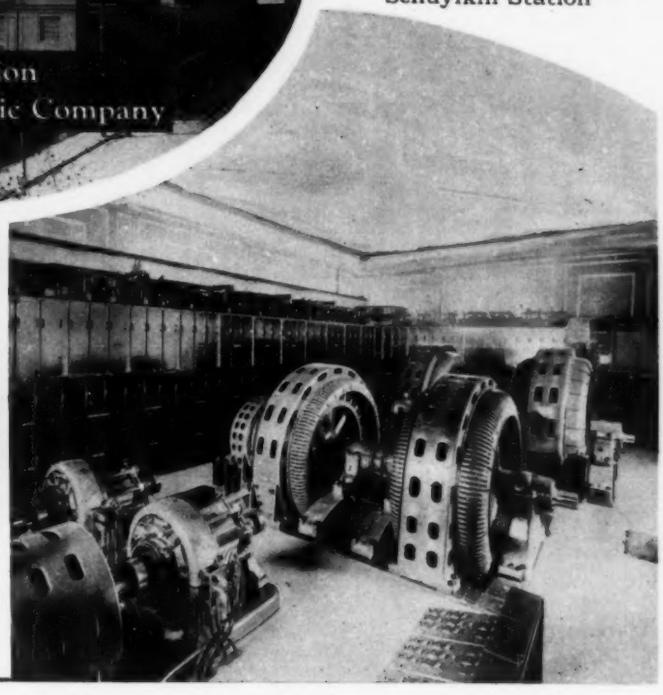
1911

Frequency changer substation with H type Oil Circuit Breakers in Schuylkill Station

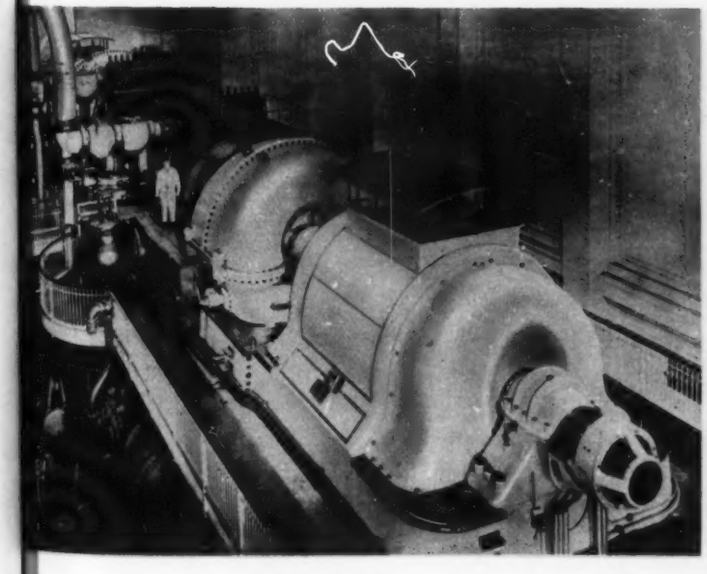


1911

Originally Type H-3 Oil Circuit Breakers in Schuylkill Substation, changed over to H-203

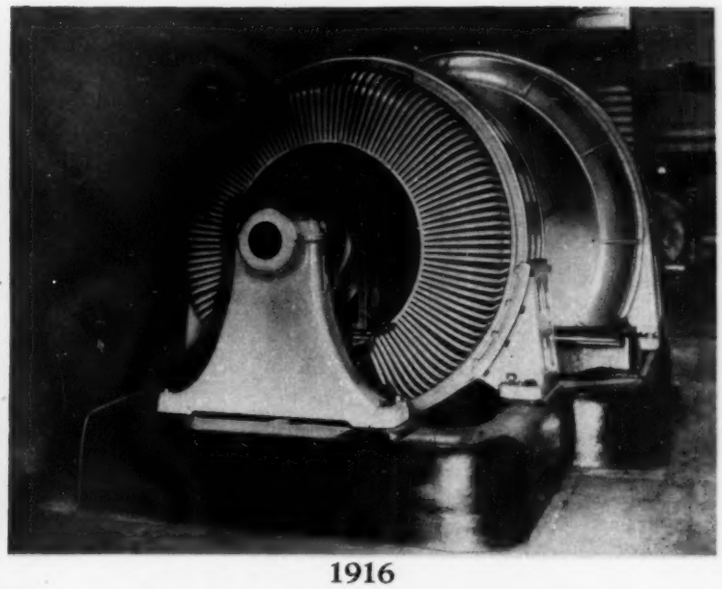


Through the P-E with G-E



1915-16

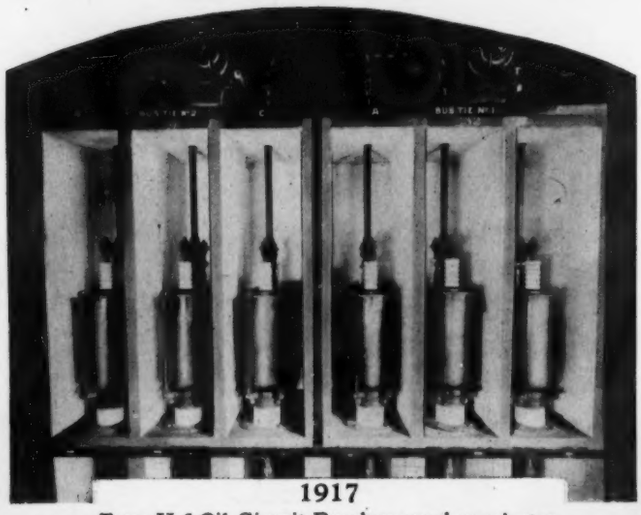
30,000-kw., 25-cycle, and 35,000-kw., 60-cycle Turbine Generators in Schuylkill Station



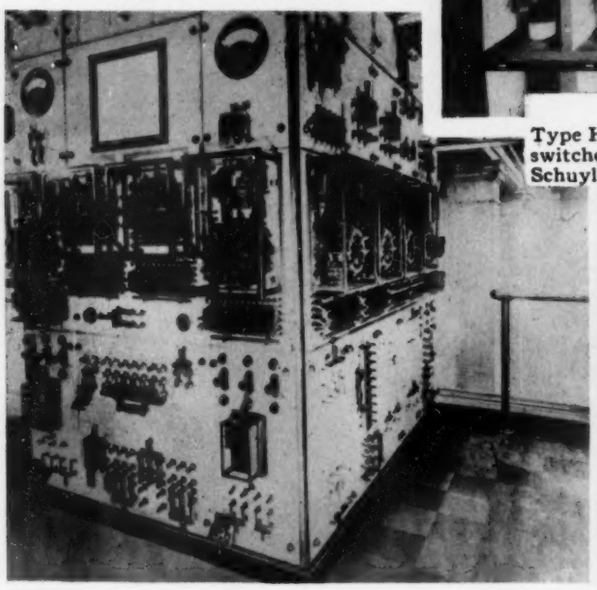
1916

One of two Synchronous Phase Converters, 5000-kv-a., which balance a single-phase railway load on the three-phase system. In Schuylkill Station

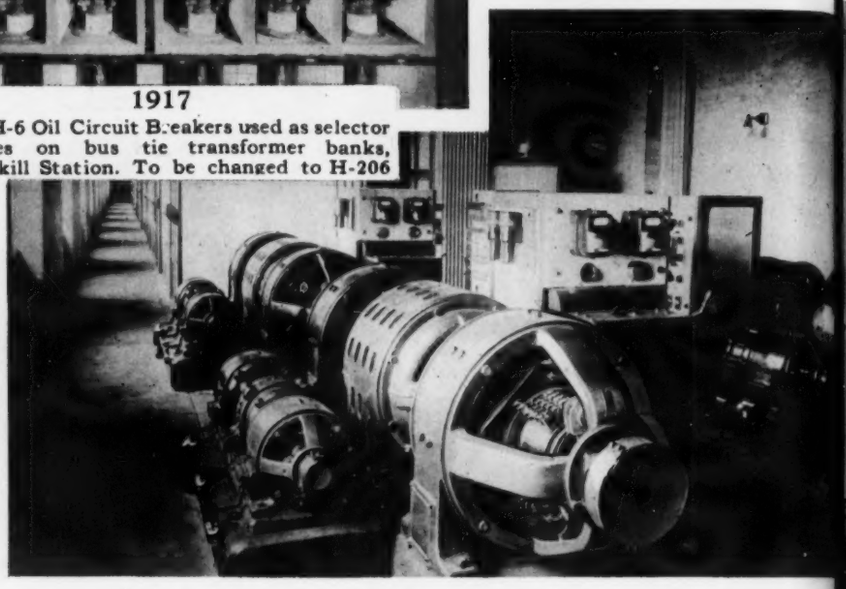
GENERAL ELECTRIC



1915-16
Installation of two Generator Voltage Regulators and four Voltage Balancer Regulators in Schuylkill Station

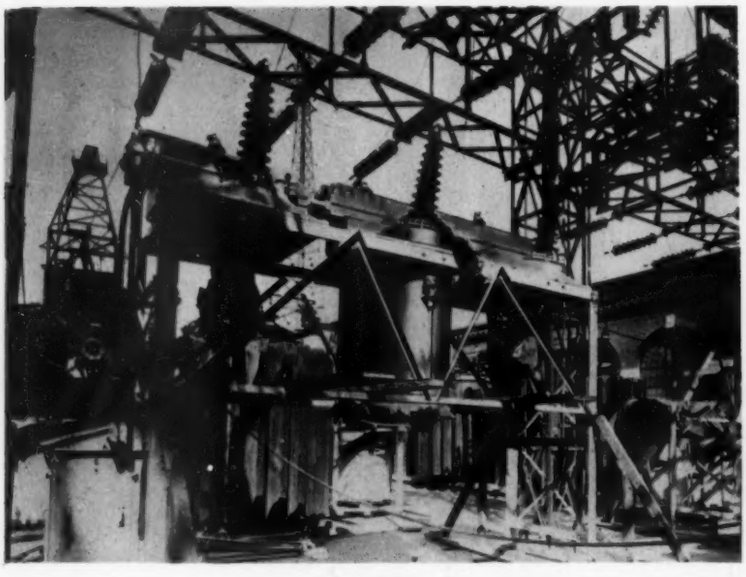


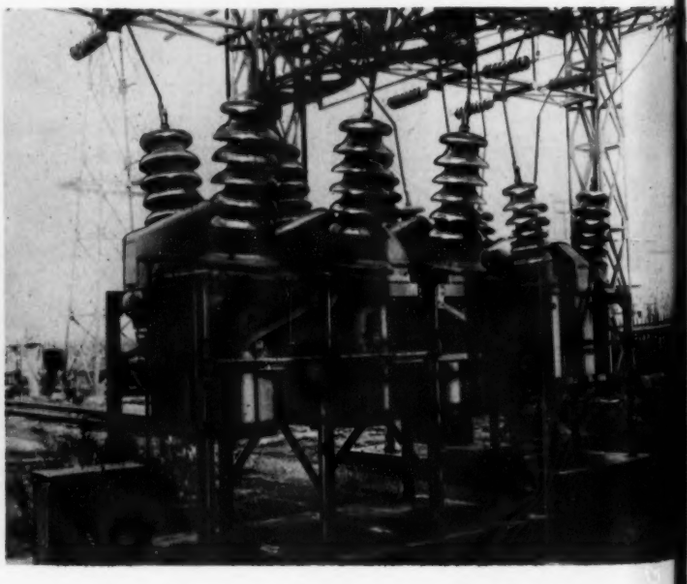
1915-16
Exciter and Booster Sets, for KR System, in Schuylkill Station. Some H type Oil Circuit Breakers in the background



1917
Type H-6 Oil Circuit Breakers used as selector switches on bus tie transformer banks, Schuylkill Station. To be changed to H-206

Through the P-E with G-E





1924
Type FKO-39 Oil Circuit Breaker being installed at Schuylkill High Line Substation on 66,000-volt generating station tie lines

1917
73,000-volt Type FKO-26 Oil Circuit Breakers on generating station tie lines at Chester High Line Substation

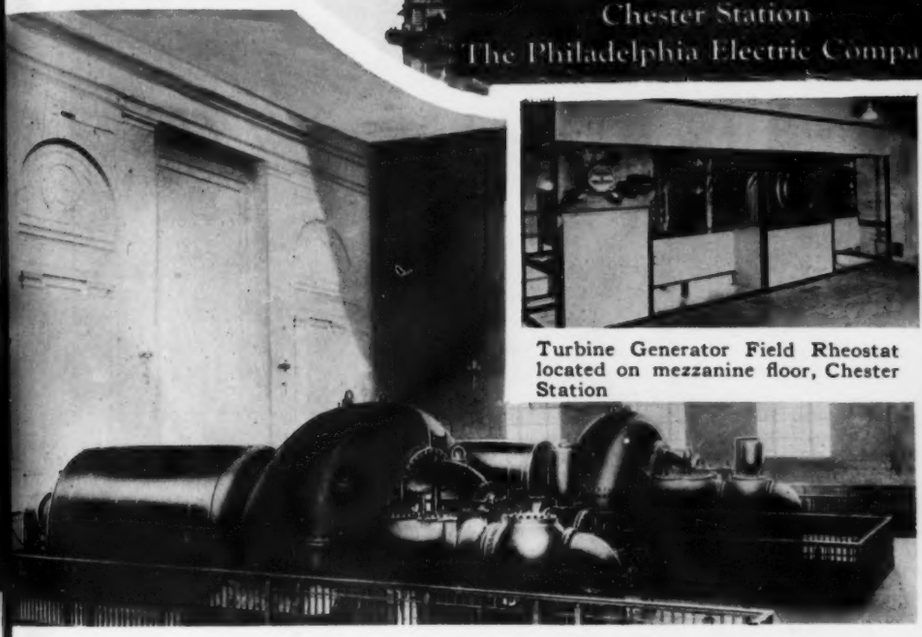
GENERAL

1918

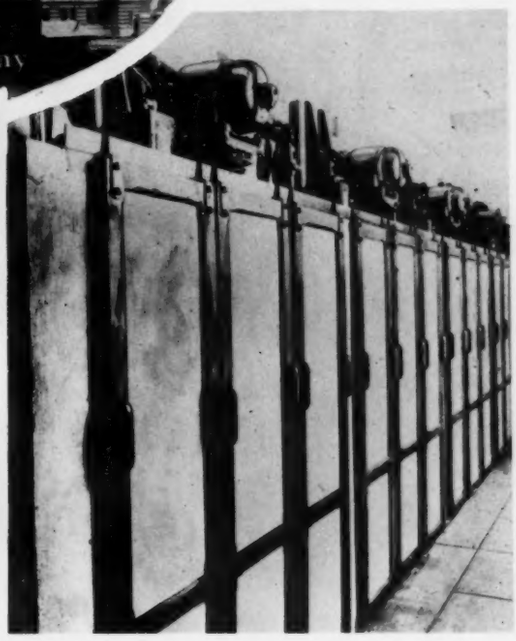
,000-kw. Turbine Gen-
tors in Chester Sta-
n. Two more units
higher kv-a. rating are
ng installed

1918

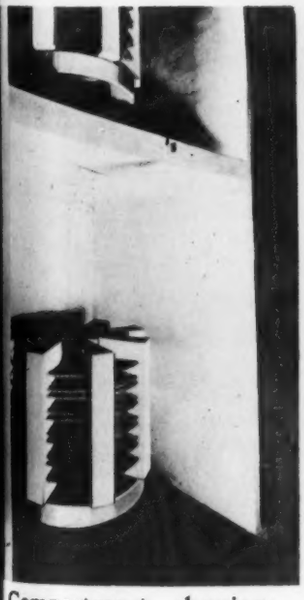
Type H-6 Oil Circuit Breakers on 13,000-volt lines, located on second floor of switch house in Chester Station



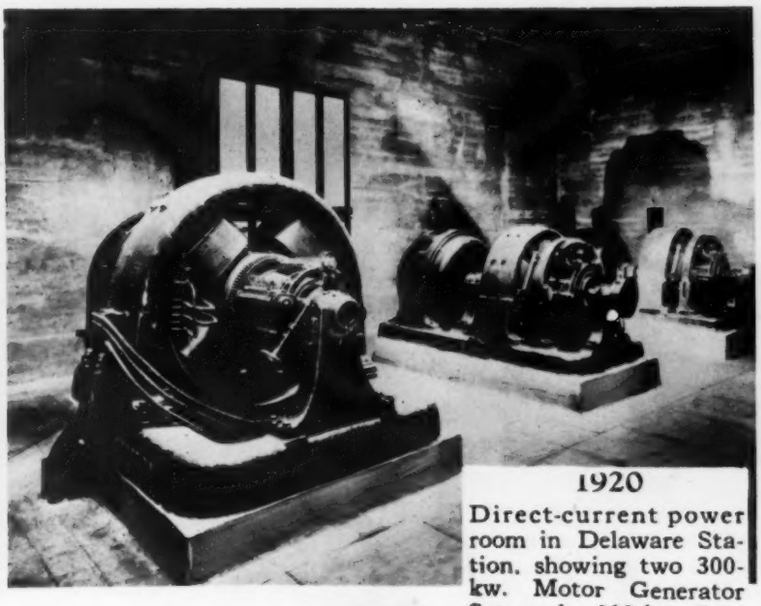
Turbine Generator Field Rheostat located on mezzanine floor, Chester Station



Through the P-E with G-E

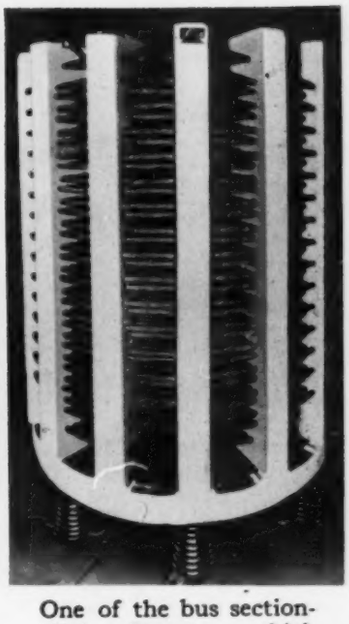


Compartment showing two G-E Reactors with resistors located on reactor floor, Chester Station



1920

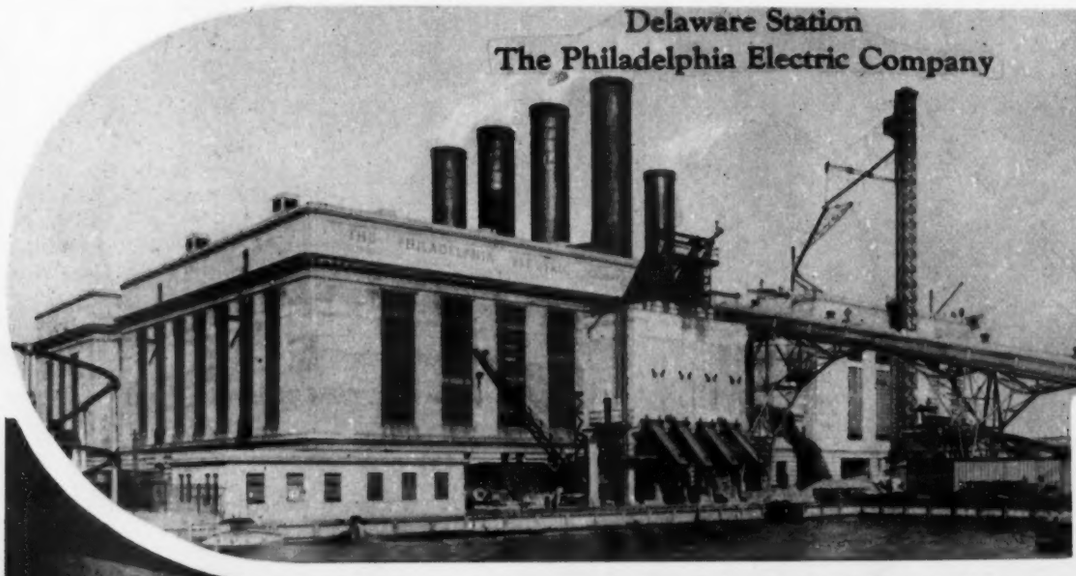
Direct-current power room in Delaware Station, showing two 300-kw. Motor Generator Sets and a 200-kw. Set

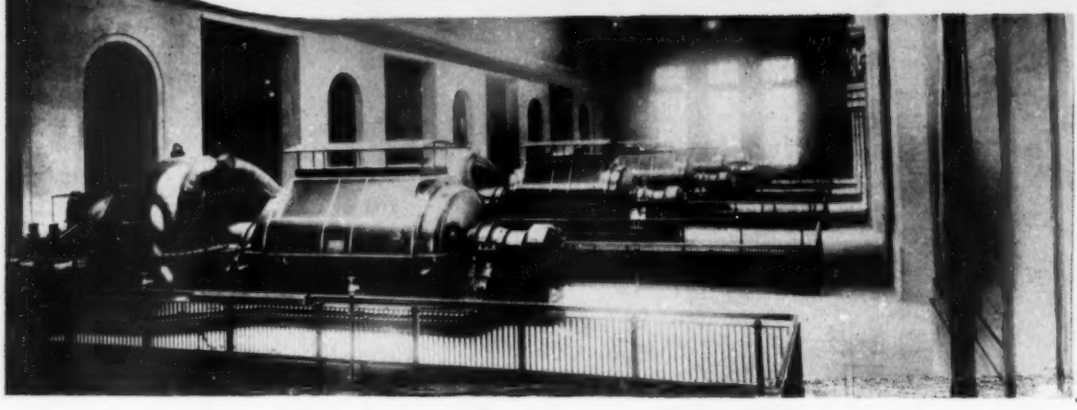


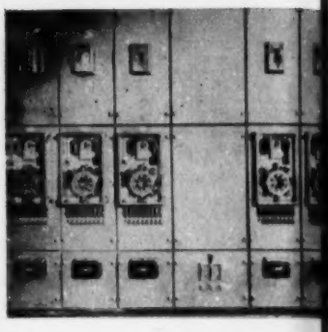
One of the bus sectionalizing Reactors, which give 5% reactive drop at 33,333 kv-a., Delaware Station

ELECTRIC

Delaware Station
The Philadelphia Electric Company

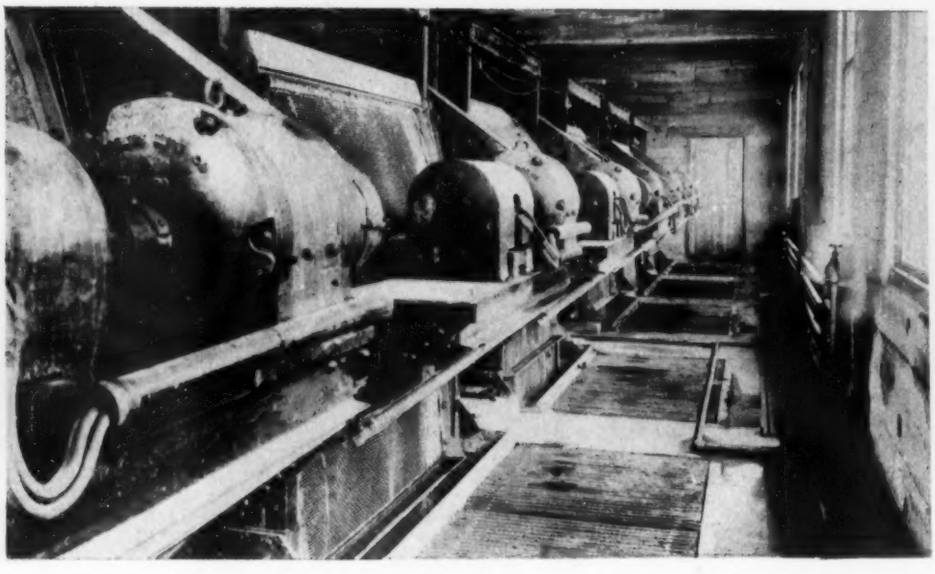




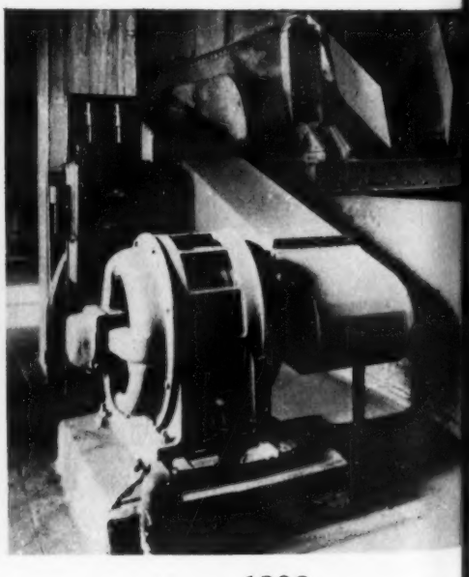


1920-23
Turbine hall in Delaware Station showing five 30,000-kw. G-E Turbine Generators. Above, the Voltage Regulators

Through the P-E with G-E

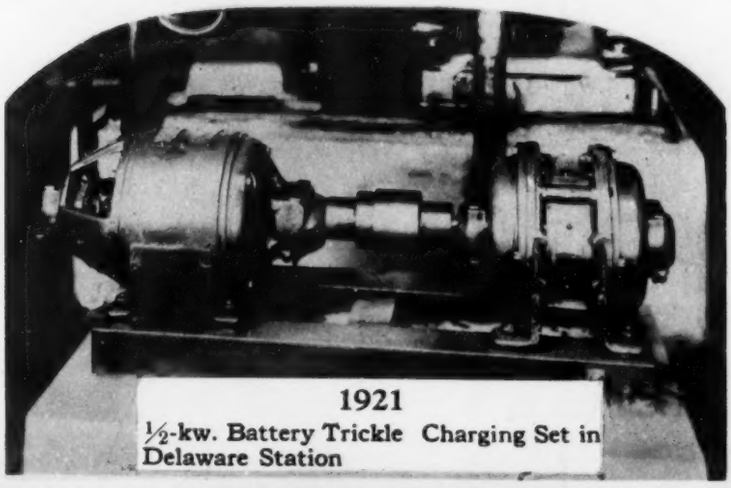


1920
View in water screening basin, Delaware Station, with six screening equipments driven by G-E Motors



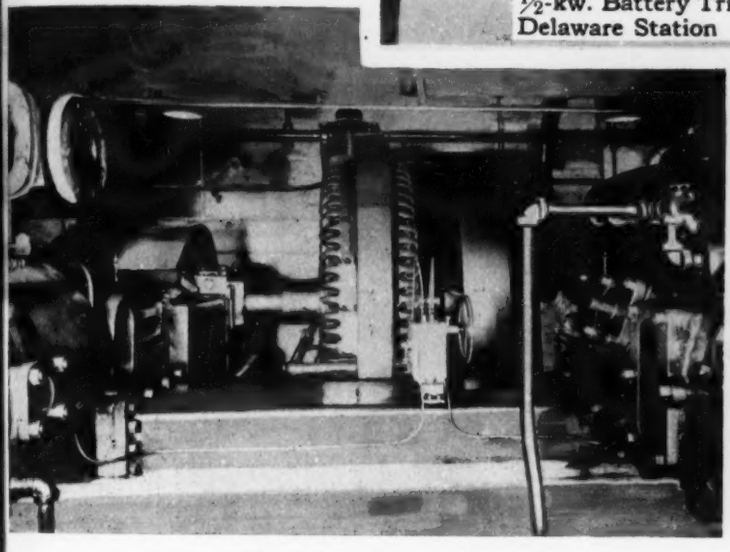
1920
In the coal tower, Delaware Station, G
Motor driving coal crusher

GENERAL

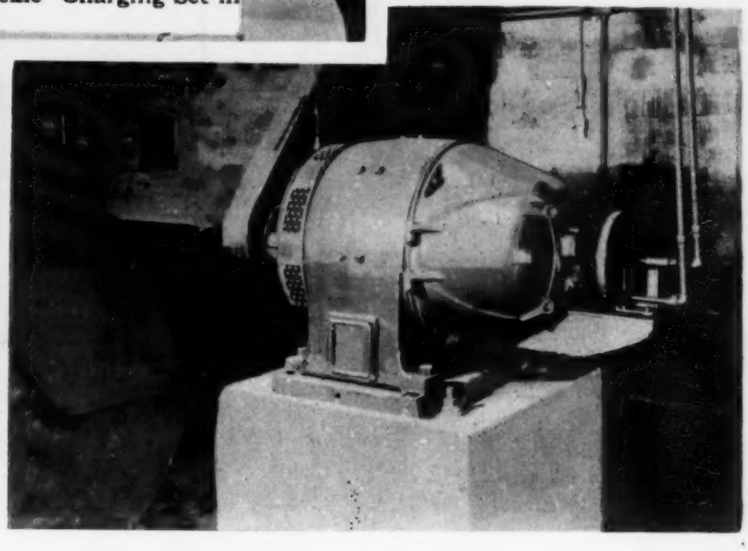


1921
½-kw. Battery Trickle Charging Set in Delaware Station

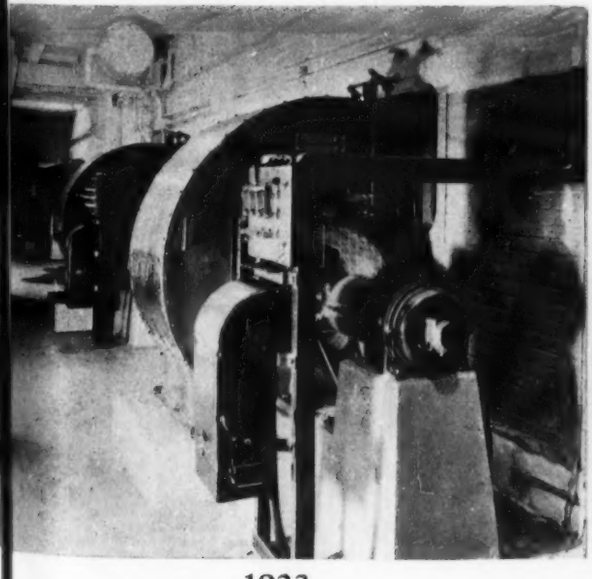
1923
One of two air compressors in Delaware Station, driven by G-E Synchronous Motors



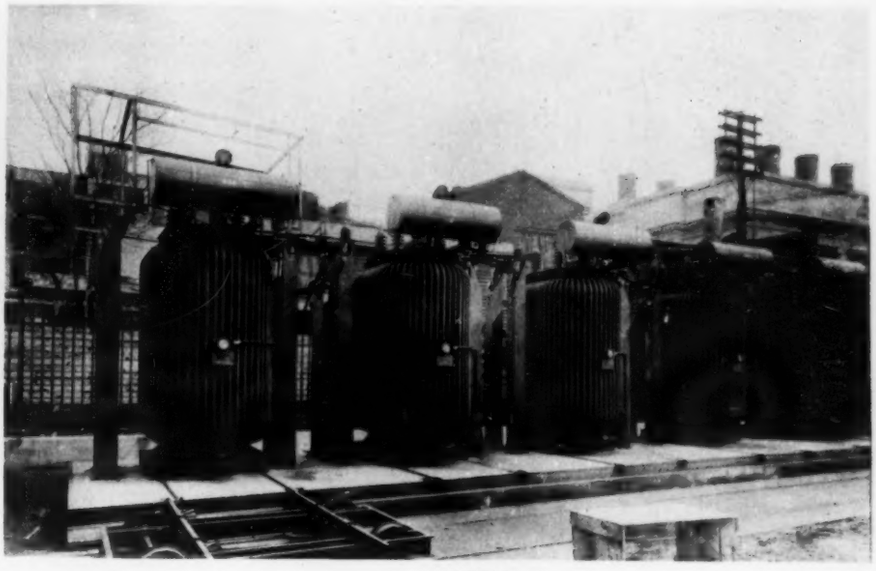
1923
Showing one of the 18 G-E Direct-Current Stoker Motors in use in Delaware Station



Through the P-E with G-E

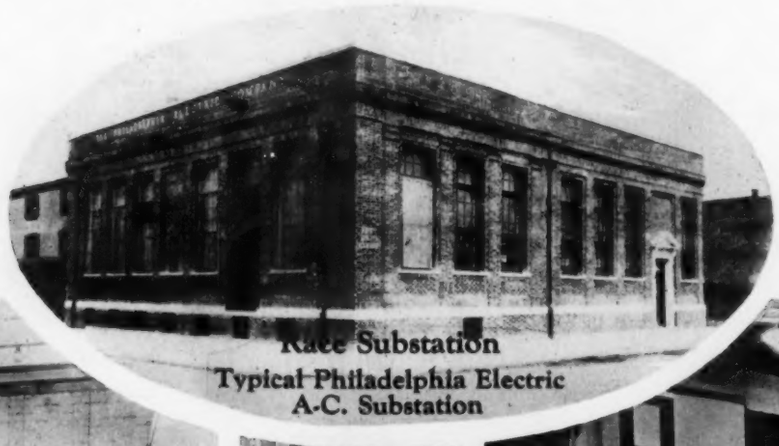


1923
View in basement of Susquehanna Substation showing transformer blowers driven by G-E Motors and Control



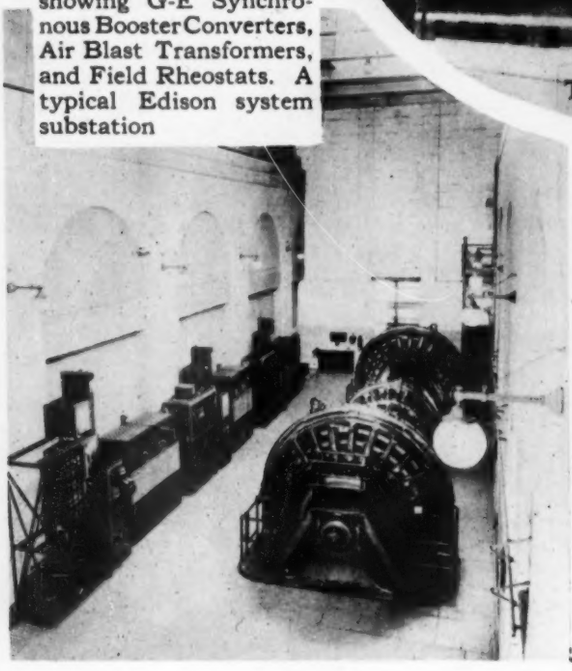
1923
Six 4000-kv-a Transformers, 13,800/27, 600 volts, at Delaware Substation. These supply a neighboring public utility through submarine cables

ELECTRIC

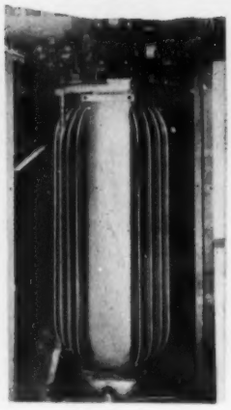


Race Substation
Typical Philadelphia Electric A-C. Substation

1921
Converter room in Franklin Substation showing G-E Synchronous Booster Converters, Air Blast Transformers, and Field Rheostats. A typical Edison system substation

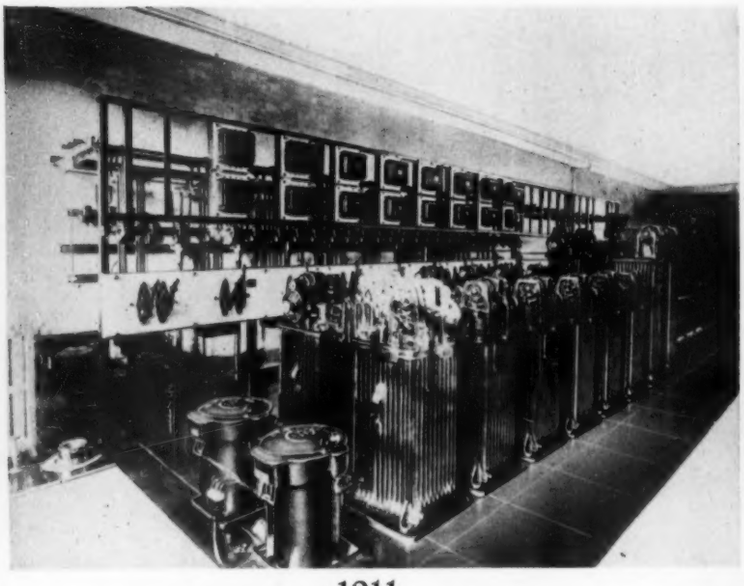


1922
Type H-203 Oil Circuit Breakers used on 13,200 volt lines. They feed to transformer banks in Race Substation



1924
G-E Voltage Regulator of new design in Hunting Park Substation

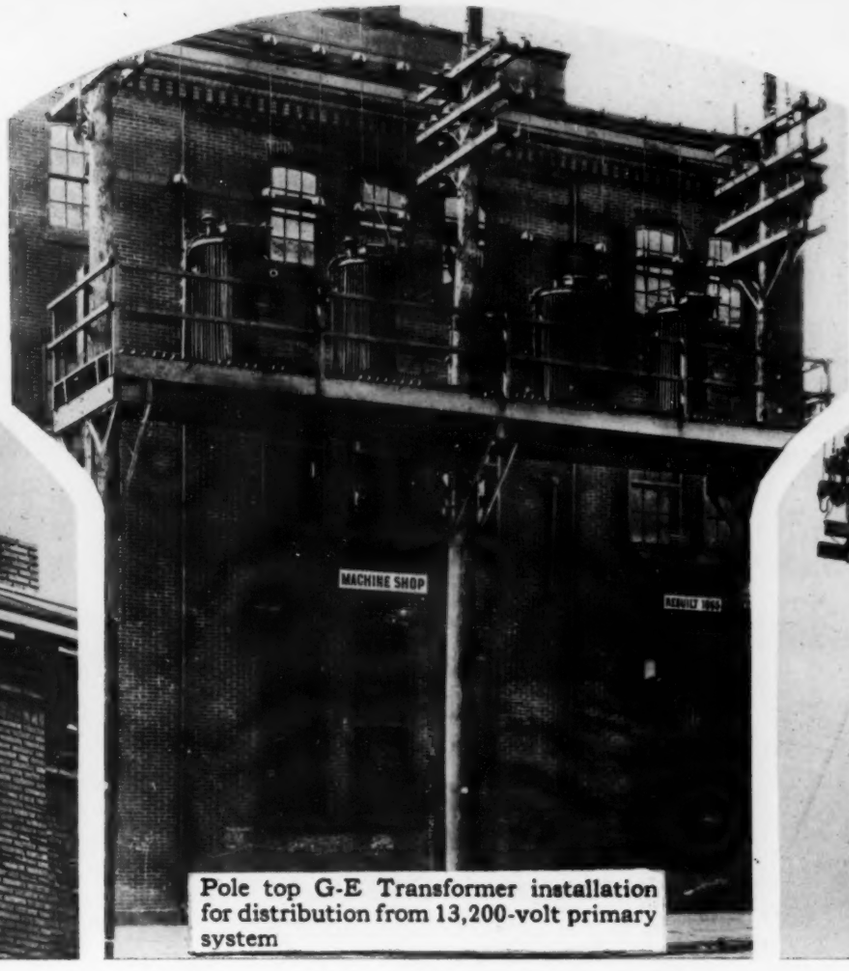
Through the P-E with G-E



1911
Feeder Voltage Regulators in Ontario Substation, showing early construction

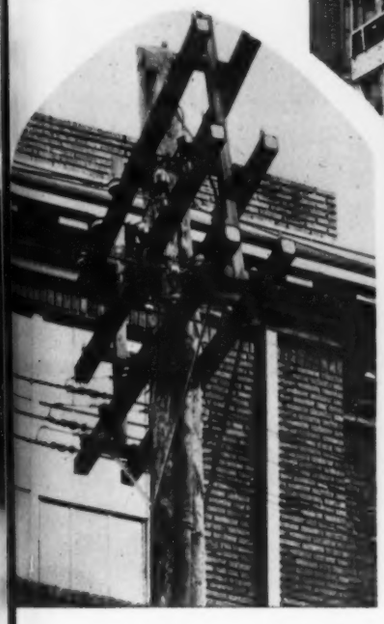
1920
2400-volt Feeder Voltage Regulators with steel barrier protection in Hunting Park Substation. Also Type H-3 Oil Circuit Breakers and G-E Control Panels

GENERAL

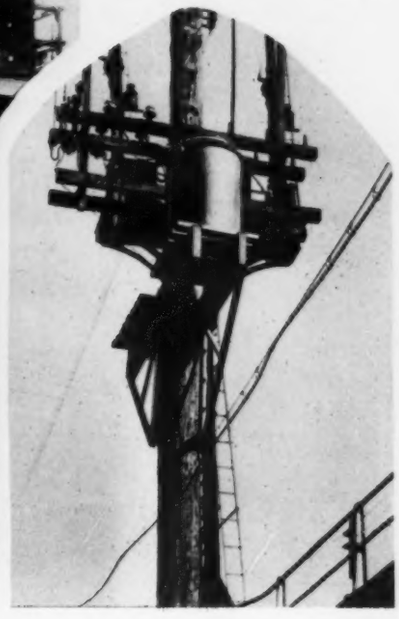


Pole top G-E Transformer installation for distribution from 13,200-volt primary system

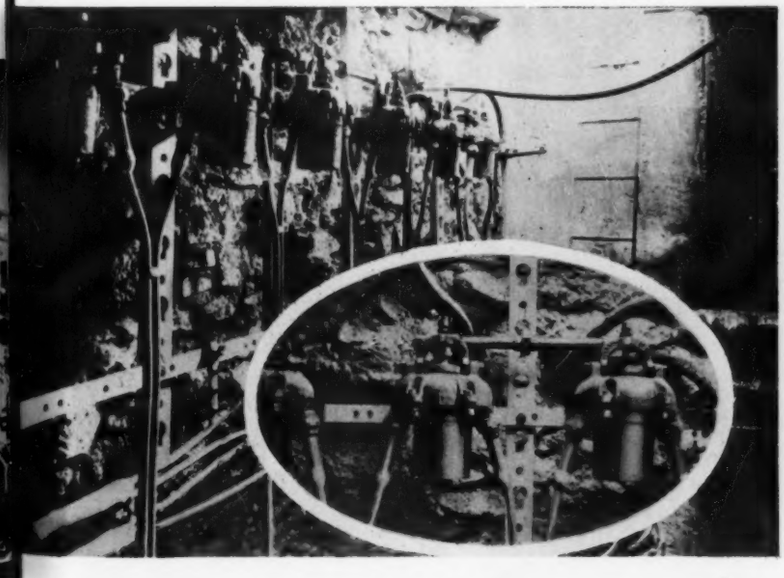
Compression Chamber Lightning Arresters on 2400-volt distribution circuit



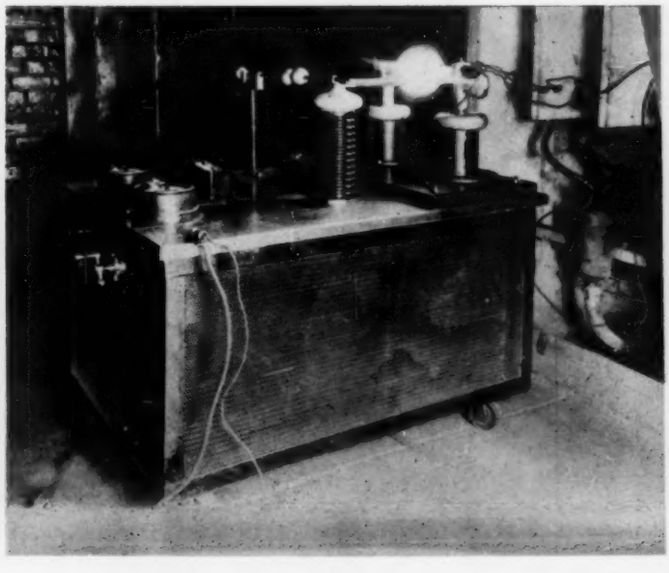
Typical installation of constant-current Street Lighting Transformer



Through the P-E with G-E

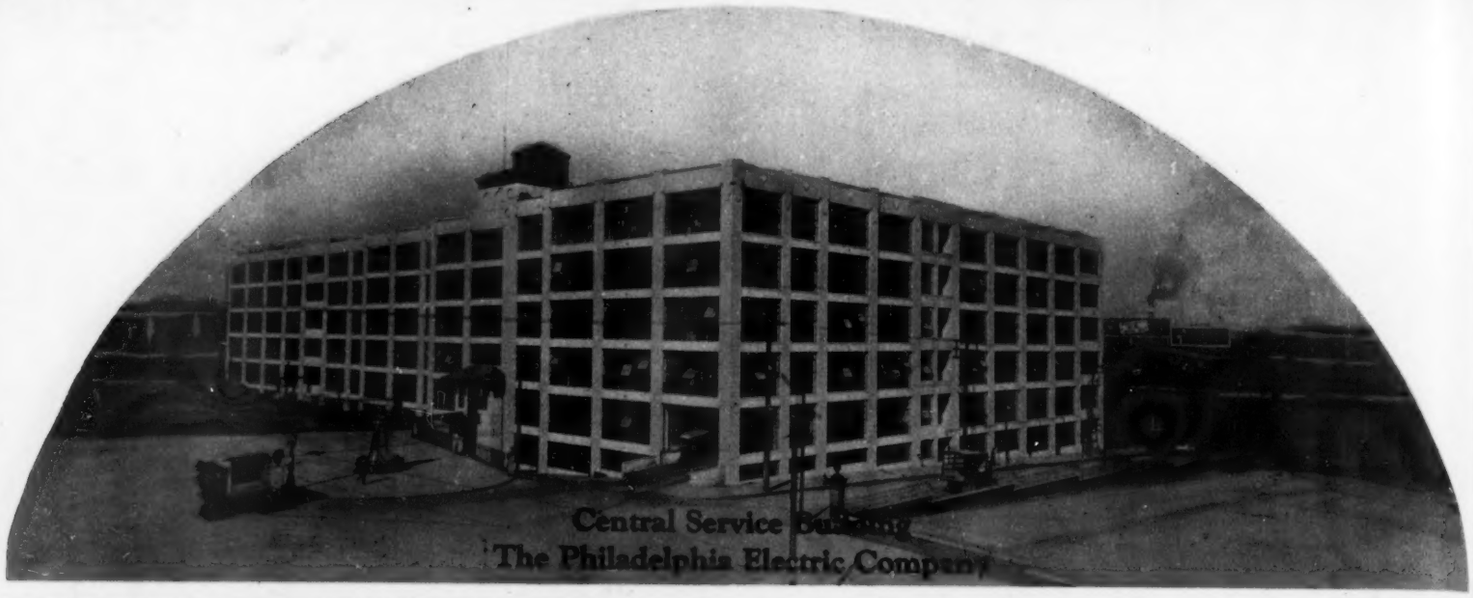


Underground installation of six D&W Subway type Oil Fuse Cutouts. Inset shows close up

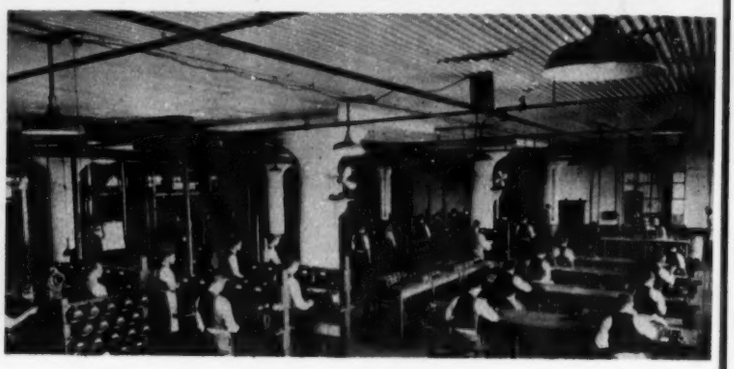


Portable Kenotron Cable Testing Set being used to detect cable faults well in advance of breakdown in service

ELECTRIC



Central Service Building
The Philadelphia Electric Company



Through the P-E with G-E

Section of general testing laboratory in the Central Service Building

Watthour Meter Testing, one of the many operations carried on in the Central Service Building

P. E. SERVICE began about thirty years ago. Today it is synonymous with *good* service, for which the Philadelphia Electric Company has built up an enviable reputation. At the same time great economies have been effected, as manifested in the company's voluntary decreases in rates during recent years.

In establishing this excellent operating record, throughout its entire development, G-E Equipment has played a prominent part as portrayed on these pages.

General Electric Company
Schenectady, N.Y.
Sales Offices in all Large Cities

GENERAL ELECTRIC

The outer finish is only a detail but it indicates Paranite superiority

Paranite finish on code wire is the last of a number of details of manufacture that are all "better than code requires."

The outside of any Paranite wire is smooth, uniform, dry, and flexible.

This sounds simple as you say it, for it's what the user needs. With Paranite wire the braided cover is impregnated with a superior grade wax compound, and the last coat is polished.

Because of these details, the compound never comes out of the braid and never gets sticky. The workman's hands are not smeared up with the compound, and the braids are never left unprotected by loss of the compound.

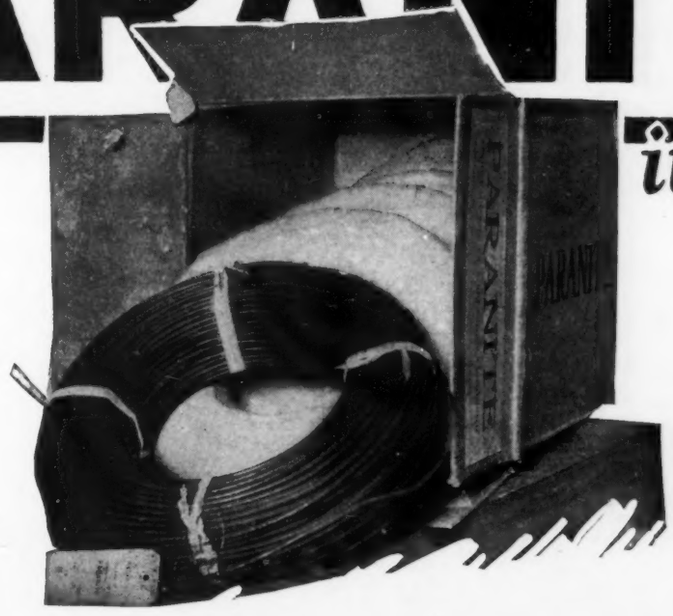
The better finish of Paranite code wire is only the outside indication of extra quality that goes all the way through. For 33 years Paranite wire and cables have been consistently "better than code requires" and all that the job requires

INDIANA RUBBER & INSULATED WIRE CO.
JONESBORO, INDIANA
63 Vesey St. New York City
810 Marquette Bldg. Chicago

If it's

PARANITE

it's right

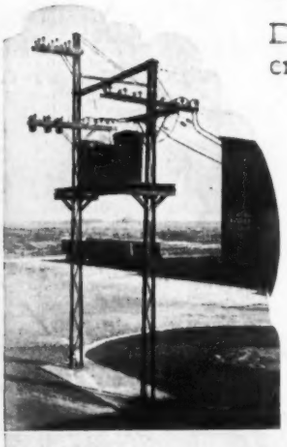


Use Bates Poles for Substations or Transformer Racks!

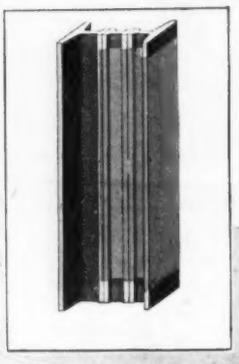
Bates Expanded Steel Poles are adaptable for every pole purpose! For transformer racks and outdoor substations they give an unusually clean cut and sturdy frame.

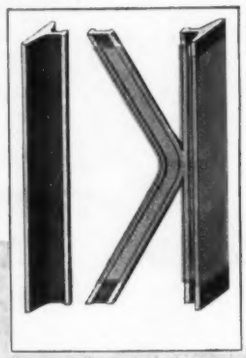
The small illustration is of a transformer rack of the usual type in use by industrial concerns, while below is shown an outdoor substation of the Ohio Public Service Company at Mansfield, Ohio.

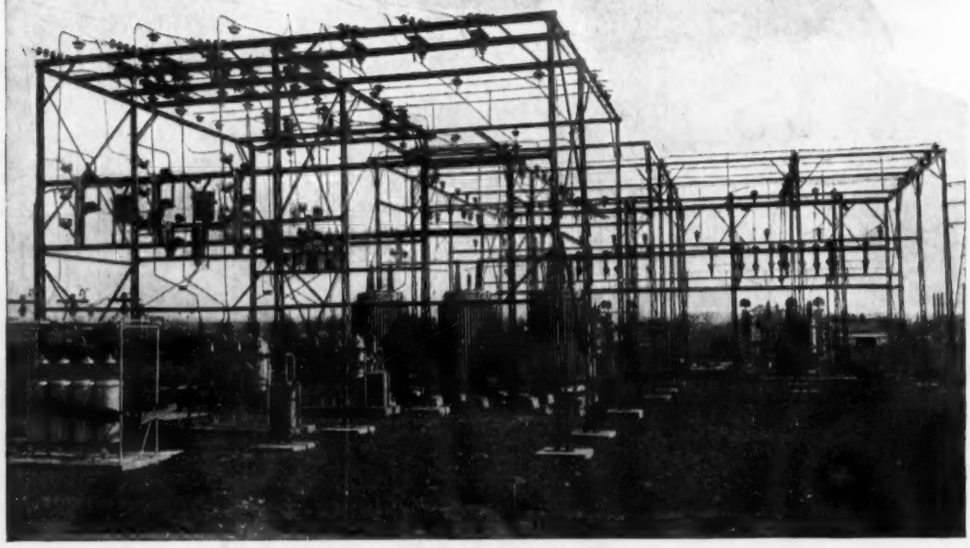
Bates engineers will be glad to work with your engineers on your present pole requirements.



Bates Expanded Steel Truss Co.
Illinois Merchants Bank Bldg.
Chicago, Ill., U. S. A.







BATES ONE PIECE EXPANDED STEEL POLES